Tradable Rights and Transaction Costs

A Comparative Analysis of Alternative Policy Instruments for Emissions, Road Use and Public Deficits

Evy Crals

DISSERTATION

zur Erlangung des Grads einer Doktorin der

Wirtschaftswissenschaft (Dr. rer. pol.) der

Universität Erfurt,

Staatswissenschaftliche Fakultät

2005

Promotor:

Prof. dr. J. Backhaus

Datum der Disputation: 5.December 2005

urn:nbn:de:gbv:547-200500672
[http://nbn-resolving.de/urn/resolver.pl?urn=nbn%3Ade%3Agbv%3A547-200500672]

Contents

1. Introduction 10
1.1. Scope 10
1.2. Theoretical framework 10
1.2.1. Market failures 10
1.2.2. Public goods 12
1.2.3. Internalization of externalities 14
1.3. Research questions and approach of the study 16
2. Tradable permits: origin and context 20
2.1. Introduction 20
2.2. Policy instruments 20
2.2.1. Voluntary initiatives 20
2.2.2. Command-and-control policy 22
2.2.3. Market-based instruments 23
2.3. History on taxes and tradable permits 24
2.3.1. (Environmental) taxes 24
2.3.2. Tradable (emission) permits 27
2.3.3. Comparing tradable permits with environmental taxes 29
2.4. Types of tradable permit systems 31
2.5. Controversy on tradable permits 35
3. Theory of tradable rights and transaction costs 37
3.1. Introduction 37
3.2. Theoretical framework 37
3.2.1. Cap and trade 38
3.2.2. Initial distribution of the permits 39
3.2.2.1. An auction 39
3.2.2.2. Allocation by criteria 42
3.2.3. Transferability rules 45
3.2.4. Temporal dimension 46
3.2.5. Geographical area 48
3.2.6. Monitoring and enforcement 50
3.2.6.1. Monitoring 50
3.2.6.2. Enforcement 52
3.3. Transaction costs 53
3.3.1. Survey of the literature 53
3.3.2. Classification 54
4. Tradable emission rights versus environmental taxes 57
4.1. Introduction 57
4.2. Design issues of tradable emission rights 57
4.2.1. Emission versus ambient permit systems 57
4.2.2. Emissions versus input trading 58
4.2.3. Absolute versus relative baselines 58
4.3. Emission rights in practice 59
4.3.1. Credit programs 60
4.3.2. Cap-and-trade programs 62

4.3.2.1. The US Acid Rain Program (Title VI) 64
4.3.2.2. RECLAIM 69
4.4. General possibilities of using tradable (emission) permits 72
4.5. General problems of using tradable (emission) permits 73
4.5.1. Issues relating to the initial allocation and distributive aspects 73
4.5.2. Issues relating to different kinds of pollutants 76
4.5.3. Issues relating to social impact and political acceptability 77
4.5.4. Issues relating to transaction costs 78
4.6. Transaction costs 79
4.6.1. Determination of relevant transaction cost categories 79
4.6.2. Environmental taxes 80
4.6.2.1. Legislative costs 80
4.6.2.2. Information costs 82
4.6.2.3. Search (planning) costs 83
4.6.2.4. Set-up costs 83
4.6.2.5. Operational costs 83
4.6.2.6. Negotiation costs 84
4.6.2.7. Contract costs 84
4.6.2.8. Monitoring and enforcement costs 84
4.6.2.9. Compliance costs 85
4.6.2.10. Conclusion 85
4.6.3. Tradable emission permits 85
4.6.3.1. Legislative costs 86
4.6.3.2. Information costs 87
4.6.3.3. Search (planning) costs 87
4.6.3.4. Set-up costs 88
4.6.3.5. Operational costs 88
4.6.3.6. Negotiation costs 89
4.6.3.7. Contract costs 89
4.6.3.8. Monitoring and enforcement costs 89
4.6.3.9. Compliance costs 90
4.6.3.10. Conclusion 90
4.6.4. Transaction Cost Comparison 91
4.6.4.1. Information and search costs 91
4.6.4.2. Monitoring, enforcement and compliance costs 91
4.6.4.3. Negotiating and contracting costs 92
4.6.4.4. Administrative costs 92
4.6.4.5. Legislative costs 92
4.6.4.6. Conclusion 92
4.6.5. Policy implications 95
5. Tradable entry rights versus road pricing 97
5.1. Introduction 97
5.2. Transportation industry context 97
5.2.1. General observations 97
5.2.2. Prices versus quantities in case of inelastic demand 100

5.3. Tradable transportation rights 103
5.3.1. Potential for permit programs in the transportation industry: three scenarios 104
5.3.2. Evaluation criteria 106
5.4. Scenarios 107
5.4.1. Tradable vehicle kilometre permits 108
5.4.1.1. Design 108
5.4.1.2. Evaluation 112
5.4.2. Tradable fuel permits 112
5.4.2.1. Design 112
5.4.2.2. Evaluation and recommendations 115
5.4.3. Tradable entry permits 117
5.4.3.1. Design 117
5.4.3.2. Evaluation 119
5.4.3.3. TEP versus other road pricing systems 119
5.4.3.4. Conclusions 121
5.4.4. Comparison of the different scenarios 122
5.5. Transaction costs 125
5.5.1. Determination of relevant transaction cost categories 125
5.5.2. Road pricing 126
5.5.2.1. Legislative costs 126
5.5.2.2. Information costs 130
5.5.2.3. Search (planning) costs 131
5.5.2.4. Set-up costs 133
5.5.2.5. Operational costs 134
5.5.2.6. Negotiation costs 134
5.5.2.7. Contract costs 134
5.5.2.8. Monitoring and enforcement costs 135
5.5.2.9. Compliance costs 136
5.5.2.10. Conclusion 136
5.5.3. Tradable entry permits 136
5.5.3.1. Legislative costs 137
5.5.3.2. Information costs 139
5.5.3.3. Search (planning) costs 139
5.5.3.4. Set-up costs 141
5.5.3.5. Operational costs 141
5.5.3.6. Negotiation costs 141
5.5.3.7. Contract costs 142
5.5.3.8. Monitoring and enforcement costs 142
5.5.3.9. Compliance costs 142
5.5.3.10. Conclusions 143
5.5.4. Transaction cost comparison 143
5.5.4.1. Information and search costs 143
5.5.4.2. Monitoring, enforcement and compliance cost 143
5.5.4.3. Negotiating and contracting cost 144

5.5.4.4. Administrative costs 144
5.5.4.5. Legislative costs 144
5.5.4.6. Conclusion 144
5.5.5. Policy implications 147
6. Tradable fiscal deficit rights versus regulation (Stability Pact) 150
6.1. Introduction 150
6.2. Micro-economic aspects 151
6.2.1. The Stability Pact 152
6.2.2. Tradable deficit rights 155
6.2.3. Design of TDR 156
6.2.3.1. Determination of the cap 157
6.2.3.2. Allocation aspects 158
6.2.3.3. Inter-temporal trading 158
6.2.3.4. Market power 159
6.2.3.4. Price information 161
6.2.3.5. Monitoring and enforcement 164
6.2.4. Summary and evaluation of a TDR system 164
6.3. Macro-economic aspects 167
6.3.1. Business cycles 167
6.3.2. Character of the budget deficit 168
6.3.3. National debt 169
6.3.4. Demographic situation 170
6.4. Germany 170
6.4.1. Germany's federal political structure 171
6.4.2. Fiscal relations 172
6.4.3. Spending and deficits of the Länder 173
6.4.4. Tradable deficit permits in Germany 177
6.4.4.1. Initial distribution 177
6.4.4.2. Coordination 178
6.4.4.3. Monitoring and enforcement 178
6.5. Transaction costs 179
6.5.1. Determination of relevant transaction cost categories 179
6.5.2. Regulation: The Stability and Growth Pact 180
6.5.2.1. Legislative costs 180
6.5.2.2. Delay costs 181
6.5.2.3. Information costs 183
6.5.2.4. Search (planning) costs 184
6.5.2.5. Set-up costs 185
6.5.2.6. Operational costs 185
6.5.2.7. Negotiation costs 186
6.5.2.8. Contract costs 186
6.5.2.9. Monitoring and enforcement costs 186
6.5.2.10. Compliance costs 190
6.5.2.11. Conclusion 191
6.5.3. Tradable deficit rights 191

6.5.3.1. Legislative costs 191
6.5.3.2. Delay costs 194
6.5.3.3. Information costs 194
6.5.3.4. Search (planning) costs 195
6.5.3.5. Set-up costs 195
6.5.3.6. Operational costs 195
6.5.3.7. Negotiation costs 196
6.5.3.8. Contract costs 196
6.5.3.9. Monitoring and enforcement costs 196
6.5.3.10. Compliance costs 197
6.5.3.11. Conclusions 197
6.5.4. Transaction cost comparison 198
6.5.4.1. Information and search costs 198
6.5.4.2. Monitoring, enforcement, compliance and delay costs 198
6.5.4.3. Negotiation costs 199
6.5.4.4. Administrative costs 199
6.5.4.5. Legislative costs 199
6.5.4.6. Conclusion 199
6.5.5. Policy implications 200
7. Conclusion 202
7.1. Introduction 202
7.2. Scientific and policy relevance 202
7.3. Design issues of tradable permits 203
7.4. Comparative transaction cost analysis 205
7.5. Discussion 208
Bibliography 210

List of Tables

Table 1:Transaction Cost Taxonomy 56
Table 2: Existing credit programs 61
Table 3: Existing cap-and-trade programs 63
Table 4: Estimates of Long-run (2010) Annual and Marginal Cost of SO2 program 68
Table 5: Chronological Transaction Costs of (Environmental) Policy Process 80
Table 6: Comparative transaction costs of market-based environmental policy instruments. 93
Table 7: Transaction Cost-effective Environmental Market-based Policy Instruments 96
Table 8: Methods to regulate road use 104
Table 9: Dependence of various marginal external costs of road usage on various trips characteristics 107
Table 10: Main design elements of TVKP, TFP and TEP 123
Table 11: Advantages and disadvantages of TVKP, TFP and TEP 124
Table 12: Relation between the three scenarios and the marginal external cost 124
Table 13: Comparative transaction costs of market-based transport policy instruments 145
Table 14: Transaction costs of effective market-based transport policy instruments 148
Table 15: Distribution of voting power in the Council of Ministers 154
Table 16: General Government Surplus in 2003 156
Table 17: Growths and deficits 2002-2004 156
Table 18: GDP at current market prices 2003 (in billion €) and TDR 157
Table 19: Fiscal deficit reduction for each Member State 161
Table 20: Summary of TDR proposal 165
Table 21: Deficit of the Länder (2001) 173
Table 22: Debt of the Länder in % of GDP (2003) 176
Table 23: Timetable of the steps in the excessive deficit procedure 182
Table 24: Comparative transaction costs of regulation versus tradable deficit rights 200
Table 25: Transaction effective fiscal policy instruments 201

List of Figures

Figure 1: Certainty about the environmental result in spite of the uncertainty about the slope of the individual MAC-curves 31
Figure 2: Product market effects of auctioned distribution..... 42
Figure 3: Product market effects of grandfathered distribution 44
Figure 4: Price of fossil fuel with inelastic demand..... 103
Figure 5: Operation of TVKP 111
Figure 6: Operation of TEP..... 114
Figure 7: Operation of TEP..... 118
Figure 8: Derivation of the market demand and supply curves of tradable permits..... 163
Figure 9: Deficit in % of GDP of the West German Länder (1992-2001). 174
Figure 10: Deficit in % of GDP of the East German Länder (1992-2001) 176
Figure 11: Complexity and enforcement under “soft” and “hard” laws 189

1. Introduction

1.1. Scope

The main purposes of this study is to compare transaction costs of tradable permit systems with other types of policy instruments and based on this comparison, to infer relevant policy options and implications for the use of tradable permits. This requires that tradable permits are first placed within a broader theoretical framework. Several elements of this framework, including different theories on market failures and the internalization of externalities, are discussed in section 1.2. Subsequently, the central research questions and methodology, which can be embedded in this theoretical frame, are described in section 1.3. This section also gives an outline of the study.

1.2. Theoretical framework

1.2.1. Market failures

The market mechanism can be thought of as a process by which the decisions taken by different agents in the economy are all co-ordinated through adjustments in prices. The case for the market as the mechanism for the optimal allocation of social resources is well known. The idea is to achieve a Pareto-efficient allocation of social resources; this means that no single economic agent can be made better off without at the same time harming another agent. Following Inman (1987, p. 649), markets fail in those cases in which they cannot prevent individuals from cheating against a mutually co-operative outcome (Paulus, 1995, p. 1). It occurs when the following conditions exist:

1. There is no adequate competition. This is the case when mergers are all too common, the result will be an increase in larger and fewer firms in many industries. In extreme cases, this results in a monopoly. The greatest threat of a monopoly is that it denies consumers the benefit of choice and competition. In the end, it will create artificial shortages and higher prices. Inadequate competition may also enable a firm to influence politics by means of economic strength.
2. Buyers and sellers have no complete information. The competitive market process as a mechanism for achieving a first-best, Pareto-optimal allocation of resources requires that each consumer is fully informed about all attributes of the commodity being purchased. If this is not the case, particularly if the seller knows more about the commodity than the buyer, market transactions will be characterized by asymmetric

information (Inman, 1987, p. 659). This leads to mistakes and thus, market failure.

3. Resource immobility exists. The efficient allocation of resources requires that land, labour, entrepreneurs, and capital are free to move to markets where the returns are the highest. The consequence of a move is a reason that may hamper the corporation from taking its business elsewhere.[1] Resource mobility is considered ideal in the competitive market economy, but it is actually much more difficult to accomplish. When resources are immobile, markets do not function as they should.
4. Inefficiency in a market economy also occurs because of the existence of public goods, i.e. goods that are non-rivalrous and non-excludable. Examples are highways, schools, national defence and the police. In the absence of government intervention, the market provides a lower than optimal amount of public goods because of the free rider[2] problem. Clearly, the market process with self-seeking consumers will fail to achieve a Pareto-efficient allocation of these goods and services.
5. Finally, in case of externalities, markets will fail. Externalities arise whenever consumption or production by one person or firm directly affects utility of another person or firm. Like public goods, externalities create a conflict between self-seeking maximizing behaviour and the attainment of a Pareto-efficient allocation of social resources. If a Pareto-efficient allocation is to result when an activity creates benefits or harm for individuals other than those performing the activity, then we require the performing agent to be rewarded or penalized according to the marginal benefits or costs created. According to Inman (1987, p. 656-657), unless all consumers have identical demands for the externality and the externality can be denied to non-payers, a market process will not achieve a Pareto-efficient allocation.

Besides these five important reasons of market failure, two other reasons often mentioned are distributional or equity considerations and (de)merit good arguments when the government encourages or discourages the consumption of a certain good because it thinks this consumption is good or bad per se (Verhoef, 1999, p. 199).

[1] There are times when a business that is located in a certain community decides to leave the region, leaving hundreds of people unemployed. Therefore, it is very difficult for a business to take those drastic decisions.

[2] The free rider problem exists because individuals do not need to reveal their preferences concerning which public goods should be provided, since they know that even without revealing their preferences they benefit from the services.

According to Inman (1987, p. 653), where markets fail to achieve efficiency, governments may succeed. As an allocator of social resources, the task of the government is to find and enforce a cooperative, Pareto-improving allocation. In that sense, governments play the role of economic institutions. Generally, this role has to be compared to the role of markets in order to determine under what circumstances governments are preferred over markets for the allocation of resources (Paulus, 1995, p. 1). However, although government intervention can often improve on market outcomes, it does not always do so. First, there often exists asymmetric information between government and private agents about various parameters that affect optimal economic decisions. Second, politicians and civil servants have their own objectives, monetary or non-monetary, and these objectives are not necessarily aimed at minimising economic inefficiencies or achieving a more desirable distribution of income when designing and implementing economic policies. Third, transaction costs can be high with government intervention and, finally, government involvement creates opportunities for rent-seeking activities and lobbying by interest groups.

Traditionally, the role of the government in relation to the market has been to distribute resources and to define and enforce property rights. Theoretically, if the government were to define property rights in such a way that would allow for correct pricing of environmental resources, their actual scarcity and cost would be reflected. This suggests a role for governments in implementing e.g. environmental protection. Different options are available to the government for this purpose: educate consumers, place quotas on the use of certain resources or ban producers from using them, or create market-based incentives to induce both producers and consumers to adjust their behaviour.

1.2.2. Public goods

The theory of public goods was first developed and debated by the continental public finance economists, notably Ugo Mazzola, Knut Wicksell, Erik Landahl, Emil Sax and others (Musgrave and Peacock, 1958). However, the public goods theory stayed in its infancy until the 1950s. Modern public goods theory can be attributed to Paul A. Samuelson. Following Samuelson, other important contributions to the public goods theory were by Musgrave (1958) and Buchanan (1968). Their contributions were the cornerstones of the modern public goods theory. Samuelson's (1955) definition gives two characteristics of public goods: indivisibility[3] and joint consumption[4]. The result of those two characteristics is that once a public good is produced, any given unit of the good can be made equally available to all. As Samuelson (1955) so succinctly states, public goods

[3] To express indivisibility, he uses the term "can not be parcelled out among different individuals".
[4] To express joint consumption, he states "all enjoy in common".

have the property that "one man's consumption does not reduce some other man's consumption". According to the definition of Samuelson, extension of the supply to one individual facilitates its extension to all. In other words, supply of a given unit to one individual, and supply of the same unit to other individuals are clearly joint products. This contrasts sharply with private goods which, once consumed or utilized as an input, can no longer be of service to others (Oakland, 1987, p. 485).

In general, goods can be classified into two groups: *pure goods* and *impure goods*. Pure goods consist of *pure public goods* and *pure private goods*. A pure public good, what Samuelson calls "collective consumption good" has the two characteristics as already described: non-rivalry and non-exclusion. However, pure public goods have also some other characteristics that pure private goods usually have not, namely externalities, the free rider and the forced rider[5] problem.

Impure goods are divided into *club*, *common-pool* and *merit/demerit goods*. A club good is an impure public good whose benefits are excludable, but partially non-rival. Club goods consist of quasi-collective goods and toll goods. A quasi-collective good is related the pure private good in the sense that it has both rivalry and exclusion features. However, a quasi-collective good generates either positive or negative external economies[6]. Toll goods[7] are partially indivisible (non-rival) goods whose benefits are shared by club members. Exclusion mechanism could be installed in return for a free or a user charge, which is a "toll". This type of goods are mostly said to be natural monopolies, which is to say that as the number of users increases, the cost per user decreases. Common-pool goods[8] are divisible but exclusion is difficult or sometimes expensive to implement. Normally, there is no need of payment to obtain or to use this type of goods and they can be consumed to the point of exhaustion, as long as the cost of collecting, harvesting or extracting does not exceed the value of the goods to the consumer. Finally, the concept of merit goods was first introduced by Musgrave (1959). Merit goods are beneficial for the entire society and, therefore, are expected to encourage production and/or consumption. For example, the construction of low cost housing for poor, rehabilitation

[5] The term of forced rider explains that the supply and the demand for some particular public goods may be obligatory. An example is elementary education. Individuals may be forced to demand or consume a public good, whereas an individual is totally free to demand for goods and services in the marketplace.

[6] Externalities are the distinguished feature of quasi-collective goods. Examples are: education and health.

[7] Toll goods are also referred to as exclusive club goods. Examples are cable television, communication networks and utilities such as electric power and water supply. However, in the recent developments, the existence of toll goods is slowly diminishing.

[8] Examples of common-pool goods are fishing in the see, hunting in wild mountains and extracting minerals from nature.

centres for elderly and mentally deficient people may be encouraged by government via several methods. Demerit goods are harmful and it is thereby expected that their consumption and/or production will be penalized. For example, the government can penalize the production as well as the consumption of demerit goods such as alcohol, tobacco products, drug use etc.

1.2.3. Internalization of externalities

External effects have been studied by economists ever since the days of Marshall and Pigou. Along with the development of the field of environmental economics, the theory of externalities has remained of great and growing importance in economic science (Verhoef, 1999, p. 197). As already pointed out, the existence of externalities leads to a deviation from the social optimum (Pareto efficiency). In the presence of externalities, market prices do not reflect full social costs (or benefits), and, for instance, regulatory taxes (or subsidies) are called for to restore the efficient workings of the market mechanism. Verhoef (1999, p. 200) describes externalities as follows: "an external effect exists when an actor's (the receptor's) utility (or production) function contains a real variable whose actual value depends on the behaviour of another actor (the supplier), who does not take this effect of his behaviour into account in his decision-making process". According to Mishan (1971), "the essential feature of an external effect is that the effect produced is not a deliberate creation but an unintended or incidental by-product of some otherwise legitimate activity". Externalities thus refer to situations where effects (harmful or beneficial) of production or consumption are imposed on others but cannot be traced or charged back to the originator. Harmful side effects that affect an uninvolved third party are called negative externalities whereas beneficial side effects are called positive externalities. The main characteristic of an externality is the separation between the affected individual and the source of the effects. Because of this, it is difficult to get the perpetrator to pay for the costs of the harmful effects or the beneficiaries to reimburse those who create benefits to society[9].

Baumol and Oates (1975, p. 17) give their own definition of externalities. They distinguish two conditions that need to be fulfilled when speaking of an externality. Firstly, an externality is present whenever some individual's (person A) utility or production relationships include real (non-monetary) variables, whose values are chosen by others without particular attention to the effects on A's welfare. This definition rules out the case, in which, someone deliberately does something to affect A's welfare. Secondly, the decision maker, whose activity affects others' utility levels or enters their

[9] An example of a negative externality would be pollution. A positive externality exists if the economic action benefits a third party. The construction on a road may cause traffic jams but local business may benefit from the traffic, which is now detoured by their shops.

production functions, does not receive compensation for his activity, an amount equal to the resulting (marginal) benefits or costs to others.

Tietenberg (2000, p. 68) describes two types of externalities: namely pecuniary and non-pecuniary externalities. When the external effect is transmitted through higher prices, pecuniary externalities arise. For example, suppose that when a firm moves into a residential area and causes nuisance for the neighbours, housing prices decrease. This decrease creates a negative effect on all those selling a house, and, therefore, is an external diseconomy[10]. However, resulting higher rents are reflecting the scarcity of land. Therefore, because the land market provides a mechanism by which the parties can bid for land, the prices that result reflect the value of the land in its various uses (Tietenberg, 2000, p. 68)[11]. A non-pecuniary externality[12] exists when the effect is not transmitted through prices. For example, the scarcity of clean air is not signalled to the polluting firm. An essential feedback mechanism via prices that is present for the pecuniary externalities is not present in the non-pecuniary externalities. Blauwens (1988, p. 73) claims that pecuniary externalities are not really external effects because they do not violate the correct functioning of the market economy. On the contrary, the market mechanism will move the prices of goods and factors and this will slow down certain consumptions or productions.

Baumol and Oates (1975, p. 15-23) elaborate on non-pecuniary externalities and distinguish two types, namely public and private goods externalities. Most of the externalities take the character of public goods[13]. For example, when the air in a city is polluted, this is for every resident and not just for one individual. Therefore, air pollution is a clear example of a public 'bad'. It is common knowledge now that, when a public good is involved, the price system will just not do. Baumol and Oates emphasize on one specific character of the public goods, namely, the fact that an increase in the consumption of the good by one individual does not reduce its availability to others. On the contrary, depletable externalities will usually be permitted to persist only if the cost of collecting a price for it exceeds the potential gains. Otherwise, private enterprises will find it profitable to take the measures necessary to eliminate the externality. In practice, the major source of depletable externalities lies in institutional obstructions that effectively prevent the assignment of property rights permitting the implementation of normal market exclusion and pricing procedures. An example is the usage of exhaustible common-property resources, such as

[10] An external diseconomy refers to circumstances in which the affected party is damaged by the externality.
[11] This is called a pecuniary diseconomy and it does not causes a market failure.
[12] In the literature, non-pecuniary externalities are often called technological externalities.
[13] Public goods externalities are also called undepletable externalities. An undepletable externality in fact exhibits two types of market failure at the same time: the external effect itself, and a public good (or bad) character.

fisheries. Consider a lake to which all fishermen have free access. The fishing of one fisherman reduces the expected size of the catch of others, a clear case of a depletable externality. The result of individual maximizing behaviour is an excessive level of fishing. A price of admission to the lake could be charged and than the efficient level of fishing activity could be attained. This example suggests that it is preferred not to think of depletable externalities as externalities but as cases where institutional impediments make it impossible to impose the appropriate prices.

Finally, Verhoef (1999, p. 201) raises the concept of congestion externalities, where each actor is at the same time both supplier and receptor of the effect. Probably the most important form of this type of externality is road traffic congestion. Economists like Pigou (1920, p. 194) and Knight (1924) already used the example of a congested highway as an illustration of the points they had to make on externality regulation.

When discussing the internalization of externalities, Ronald Coase (1960) argued that, to the extent that the externality is Pareto-relevant[14], exchange will tend to take place, hence internalizing the effect and guaranteeing an efficient outcome. Although much of his discussion was posed in terms of liability for damages, the implicit model for Coase's analysis is one that assumes all property rights to be well defined and enforced and, hence, tradable. This basic Coasean analysis presumes that entitlements are protected by a property rule, insuring that, absent transaction costs, the operation of the market will effectively internalize a potential externality (Buchanan and Faith, 1981, p. 95-96). However, in cases where individuals acting on their own can not attain an efficient solution by bargaining, there are several ways in which the government can intervene and correct the market inefficiency. Examples are regulation, (Pigouvian) taxation and tradable permits. This thesis focuses on the possibility of using tradable permits to internalize external effects.

1.3. Research questions and approach of the study

In this work, the concept of tradable permits in externalities is analyzed. To be able to assess the problems and possibilities of using tradable permits for

[14] A Pareto relevant externality exists where the behaviour of one affects the payoff of another and there exist potential arrangements for modifying behaviour so as to make all parties better off. This means that each person voluntary enters into trades to obtain factors and goods that have more utility to the individual then the original set (Pareto-better trades). Any opportunity of this sort that has not yet been consummated is referred to as a Pareto-relevant externality (Buchanan and Stubblebine, 1962). If people have knowledge of them, and they are not overwhelmed with transaction costs, the market will internalize all Pareto-relevant externalities, when it is in equilibrium. People will then have made all of the mutually advantageous trades that are possible.

ecological and/or other purposes, the concept of tradable permits is described in the second chapter. Tradable permits are an example of market-based instruments. A more detailed description and analysis of the different policy approaches to reach certain policy goals are first given. Within the literature on tradable permits, there is a long history in which tradable permits are defined, described in detail and also used in practical cases. This literature survey is also given in the second chapter, along with a description of the different types of tradable permit programs. These programs are compared with each other, highlighting their own problems and possibilities. The theoretical foundations of tradable property rights are essential to understand how a system of tradable permits should be organised in a perfect world.

In chapter 3, based on the previous idea, the construction of a tradable permit system is described with its design features. This will provide a more in-depth theoretical treatment of the instrument and also an analysis of its many different design possibilities. This theoretical framework is developed based on the transaction costs and property rights theory. This analysis will give an answer to the following questions:

1. When is a cap-and-trade system best used?
2. What are the different possibilities of initially distributing the permits?
3. What are the advantages and disadvantages of inter-temporal trade?
4. On which scale can the permits be distributed?
5. Are there adverse effects on competition?
6. Which other effects can a system of tradable permits bring about?
7. What are the different monitoring and enforcement issues that need to be taken into account when implementing tradable permits?

The central research question, namely to compare transaction costs of tradable permit systems with those of other policy instruments, is analysed within the context of particular case-studies, i.e. the development and use of tradable permits in emission rights, transportation rights and fiscal deficit rights.

A tradable emissions system is based on the principle that the cost of emissions reductions varies from facility to facility. When each facility is set a limit on its emissions by the regulators, some facilities may be able to reduce emissions more than required at a fairly low cost. They may choose to reduce emissions levels below the required levels and sell the excess pollution rights to another source that is facing a higher cost of reducing its pollution. This theory of emission rights is described in detail in chapter 4. Furthermore, several nations, especially the United States, have already implemented systems of tradable permits to limit, for example, greenhouse gases. The most well-known program is the “Clean Air Amendments” of 1990, which was the first major legislative effort to deal with a large and

continuing pollution problem by means of tradable emission allowances. This program will be discussed and also other programs, such as for example the RECLAIM program in California, will be described in this chapter. These case studies will help to understand the practical implications of introducing a system of tradable permits. Furthermore, this fourth chapter provides an overview of the most important problems and possibilities of using tradable permits in externalities. Tradable permits are attractive because of different reasons. For example, they are effective, efficient and give a clear incentive for technological development. Furthermore, the initial allocation can limit the excess burden that is typical for taxes. There are also a lot of problems with implementing tradable permits. Examples are: the existence of prohibitively high transaction costs and market power. All the general problems and possibilities of using tradable permits will be thoroughly discussed. Furthermore, a transaction costs analysis will be conducted by comparing all relevant transaction costs of tradable emission permits and environmental taxation.

In chapter 5, the design of a tradable transportation permit system is analyzed. In addition to the problems of designing and implementing tradable permits systems in general as well as in emissions rights, as described in the previous chapters, their use in the transport sector involves some specific considerations. The design of a tradable permit system in the transport sector will take into account the following aspects:

1. What are the objectives of the system and its basis characteristics, such as the physical basis of permits, the conditions under which the transfer of permits can take place and the legal status of the permits?
2. What are the criteria for the initial allocation of the permits?
3. Will temporal and spatial flexibility be introduced in the system? Which flexibility options (e.g. banking, borrowing) are suitable for this system?
4. How will the trade be organised?
5. What are the means of monitoring and enforcement, such as enforcement of penalties and fines and verification of required performance?
6. What are the expected effects of this system? Will it have an impact on the competitiveness and market power? Is it compatible with existing legal and institutional frameworks, regulatory regimes, and other instruments such as taxes? What are the distributive aspects? Is the system politically and socially acceptable?

For the comparative transaction cost analysis of tradable transportation permits, transaction costs of tradable entry rights and road pricing are compared.

In the sixth chapter, rights in deficit spending are studied. National fiscal deficits can be seen as external effects that weigh heavily on the Euro-market and affect all members of the European Union. To deal with the problem, the European Union chose a set of strict norms and standards to which countries have to apply. This is a clear example of a traditional 'command-and-control' policy. In this chapter, research is done about the introduction of tradable permits in deficit spending. Those countries who are in a need for extra deficit spending, can buy extra permits from other countries that do not have that need. The Stability Pact specifies ceilings for general government deficit, thus including deficits incurred by state, provincial and local governments. We note that Germany will violate the deficit rules for the second year. A sizable share of the federal government expenditure is canalized through state and local governments. Because the local governments and states question the constitutional status of the Pact, and they do not comply with the total allowed deficit spending, Germany exceeds the EU deficit limit. The tradable deficit permits system suggests a solution for this problem, if local governments are allowed to borrow and trade permits. After having received its initial allocation of permits, the federal government should distribute it among its different jurisdictions. All jurisdictions will then be allowed to act on the permits market, so that the final level of deficit spending will not exceed the limit. The design of such a system is described, based on the theoretical aspects from a tradable emission permit system. Again, transaction costs of tradable fiscal deficit permits will be compared with the current regulation, more specifically the Stability Pact.

Finally, chapter 7 presents the conclusion in which the objective of this book is reflected upon by using the theoretical framework provided before. On the basis of the comparative transaction costs analysis, an assessment is made to find out which policy instruments can be implemented with low transaction costs. Finally, the chapter considers the limitations of this analysis and sketches some directions for further research.

2. Tradable permits: origin and context

2.1. Introduction

In this chapter, the main sources of origin of the idea of using taxes and tradable permits for ecological purposes are described within the context of the economic approach to environmental problems. The chapter starts with a description of the different policy instruments to reach environmental goals, namely voluntary agreements, command-and-control policy and market-based instruments. Although Stavins (2002, p. 2) considers four major categories within market-based instruments, taxes and tradable permits stand out since both rely on price signals to induce polluters to reduce pollution. Taxes and tradable permits are therefore further analyzed in the remaining paragraphs of this chapter. Besides the history of these two instruments, we will also elaborate on the different types of tradable permit systems. The chapter ends with discussing the controversy on a tradable permits approach.

2.2. Policy instruments

In the literature, the different policy instruments to curb pollution and reach environmental goals are voluntary initiatives, command-and-control policy and market-based instruments. These three instruments will be discussed in depth in the next sections.

2.2.1. Voluntary initiatives

Voluntary initiatives refer to measures which are used to motivate individuals to voluntarily change their behaviour with regard to the environment[15]. The most important characteristic is that individuals are not forced to change their behaviour with regard to the environment. This means that the (voluntary) measures are not previously mandated by government by legislation or intervention. The instrument has grown out of practice, not out of theory. The increasing pressure on the "shared responsibility" for environmental protection by government and the industry enhanced the use of voluntary initiatives. Under certain conditions, these initiatives can develop in a promising additional instrument in national or European policy.

Voluntary initiatives exist in many variations which all carry elements of the national, cultural or economic context of their use. Different forms of

[15] Paulus (1995, p. 22) refers to voluntary initiatives as social regulation instruments. They are also sometimes called persuasive instruments.

voluntary initiatives are: self-regulation, co-regulation, responsible care programs, behaviour codes, own intentions, voluntary environmental reporting, registrations with environmental care systems such as ISO 14000, environmental labelling and agreements between the government and the industry (Crals and Vereeck, 2004b). All these types include three main instruments: unilateral commitments made by for example polluters, negotiated agreements between industry and public authorities, and public voluntary schemes developed by environmental agencies (Bernheim, 2001, p.193). Unilateral commitments made by polluters consist of environmental improvement programs set up by firms and communicated to their stakeholders. An example would be where a firm commits itself to some combination of reducing its emissions by 20 per cent over five years. In the public voluntary schemes, the public authorities set standards to be followed, or targets to be attained and participating firms agree to meet these targets. An example is compliance with the Eco Management and Auditing Scheme (EMAS)[16] of the European Union, which as been available to firms since 1993. Negotiated agreements are agreements between a sector or group of sectors to meet one or more overall targets. A common example in a number of countries in the E.U. is a commitment on the part of those in the packaging chain to meet an overall re-use and recycling target, by a pre-specified year (Higley and Lévêque, 2001, p. 5-6).

There is little information about the environmental efficiency of voluntary initiatives. The prime reason is that a lot of voluntary initiatives are still running and no conclusions can be made yet. The lack of base lines and reference points for emissions is a serious disadvantage of voluntary initiatives. If those base lines would exist, the effects of voluntary initiatives could be compared with these points and conclusions could be made. Another disadvantage of voluntary initiatives is the danger of free riders. This means that a part of the regulated sources are not complying with the goals of the voluntary initiatives[17]. Because voluntary initiatives neither give a uniform incentive to reduce emissions with regard to individual abatement cost functions nor effectively prevent free-riding by individual firms or entire sectors, the choice for using them as a policy option is not driven by the criterion of cost-effectiveness. Finally, transaction costs of voluntary initiatives can be quite high for state authorities and industrial or other organizations. These costs include costs for collecting information on available technology; information on possible partners for the voluntary agreements, contractual costs such as lobbying and monitoring costs after an

[16] Firms that apply for EMAS certification must have an environmental policy in place, conduct an environmental review of its sites, set and implement an environmental improvement program and environmental management systems, and have its policies and management system reviewed to verify that they meet the requirements.

[17] Formal sanctions are usually not part of voluntary programs which enhances the risk that the programs will have no effects in the firm whatsoever.

agreement is reached[18] (Bizer, 1999, p. 154). But there are also some favourable qualities. On the one hand, regulated sources do not lose financial means such as the cost of taxes on emissions and the cost of the purchase of emission rights. This gives the regulated sources more means to invest in measures for emission reductions. Even if the emission rights are distributed for free, they still have to pay for additional emissions. On the other hand, voluntary initiatives are a proactive and participative approach of the industry for environmental problems. This participative approach gives the regulated sources the advantage that they have more influence on the goals of the regulations and the way to achieve those regulations (Bernheim, 2001, p. 197-198).

2.2.2. Command-and-control policy

This policy is the most familiar for reaching environmental goals. They influence directly the behaviour of individuals with regard to the environment. Examples are standards, limits on the amount of pollution allowed to enter the natural environment, specifying abatement technologies and establishing pollution reporting systems.

Standards are the most known example of the command-and-control policy. Two types of standards will be briefly discussed, namely, ambient standards and emissions standards. An ambient standard defines an overall quality target for air or water in a region. It is often used to maintain adequate pollution controls. An emission standard defines specific limits on the volume of contaminants which can be released to the environment. They are applied to specific sources, for example firms, or to pieces of equipments, for example automobiles. They can take two forms: (1) performance standards specify the quantity or concentration of emissions per unit of time, and (2) technology standards specify particular equipment or processes that must be used.

The command-and-control policy has the potential to be effective but it mostly criticized because of its inefficiency and the absence of the incentive to innovate. Furthermore, command-and-control regulations tend to freeze the development of new technologies. Standards discourage adoption of new technologies and there is little or no incentive for industries to exceed their control targets. An industry that adopts a new technology is not rewarded and is not given the opportunity to benefit financially from its investment. Regulations can also be difficult to enforce and costly to administer. Rising costs and budget constraints have made regulation less attractive than economic instruments. Each plant, or at least each industry, must be analyzed in detail to determine the appropriate level of emission

[18] Such monitoring costs might accrue to individual firms or to industrial organizations. Enforcement costs are necessary where monitoring shows non-compliance with mandatory standards or agreements.

control. This is very costly and also a lot of errors can occur. The information problem is another problem of a command-and-control policy. The regulators are relying on correct information from the polluter, either in terms of emissions or in terms of costs of control. But the polluters have an incentive to distort the information given. In conclusion, we mention the inflexibility of the command-and-control policy. Those subjected to regulations have no choice in how they reach these environmental and social goals.

2.2.3. Market-based instruments

Stavins (2000, p.1) defines market-based instruments as: "regulations that encourage behaviour through market signals rather than through explicit directives regarding pollution control levels or methods"[19]. Most importantly, they give flexibility at actors and create an incentive to search for more efficient ways of reaching environmental goals.

In theory, if market-based instruments are well designed and implemented, they allow the desired level to be reached at lowest cost by providing incentives for the greatest reductions in pollution by those firms that can achieve these reductions most cheaply. In contrast to command-and-control policy, market-based instruments have the potential to provide an incentive to industries to adopt new technologies (Downing and White, 1986). A further potential benefit of using market-based policies may arise where these raise revenues, for example emission taxes or auctioned tradable permits.

There are also some potential disadvantages and limitations on the applicability of market-based instruments. One concerns the case where the users of natural resources have some degree of monopoly power in the output market. Firms may make use of their monopoly power to increase profits by reducing output below the competitive level. The imposition of an environmental tax may then have the effect of inducing further reductions in output, below the socially optimal level. Command-and-control policy, on the other hand, may not include reductions in output on the same scale, and therefore may not add to the existing costs of monopoly power (Bari, 2002, p. 10). Another problem with market-based instruments is that the distributional effects may be unacceptable, as in the case of taxes on fossil fuels to restrain the greenhouse effect or to conserve the use of energy. There are also further issues, such as the costs of administration, the ease and effectiveness of enforcement, and the likely level of public acceptance, about which theory only gives a certain amount of guidelines.

[19] In the literature, market-based instruments are also referred to as incentive-based, market conform or economic instruments.

Stavins (2000, p. 2) considers four major categories within the market-based instruments: pollution charges, tradable permits, market barrier reductions[20] and government subsidy reductions[21]. However, taxes and tradable permits stand out as market-based policy instruments since both rely on price signals to induce polluters to reduce their emissions and the external costs they impose on society (Norregaard and Reppelin-Hill, 2000). The history on and description of these two instruments are further discussed in the next sections.

2.3. History on taxes and tradable permits

The economic rationale of environmental taxation is based on the work by Pigou (1920) who pointed at the divergence between private and social costs. He asserted that the unremedied prevalence of external costs would lead to suboptimal social outcomes. Following Pigou, levying an ecological tax confronts polluters with the true social (private plus external) costs of their activities, who, in response, will reduce their emissions. Coase (1960) questioned the need of government activism and pointed out that, under certain circumstances, voluntary negotiations would also lead to the internalization of external costs. In other words, a market in externalities can be set up. For instance, pollution rights can be distributed by an environmental agency up to the amount of total pollution deemed acceptable. Trading of such rights among polluters creates a market for pollution with prices signalling external costs and providing clear incentives to reduce emissions (Norregaard and Reppelin-Hill, 2000).

2.3.1. (Environmental) taxes

Following Pigou, the external costs of pollution are not reflected in prices, which, by consequence, lead to a suboptimal market equilibrium. The Pigouvian policy prescription in such case is the imposition of a tax. An environmental tax set equal to the external cost will, in theory, lead to the optimal level of production and emission reduction. This assumes, however, that the taxing authority has full knowledge of all relevant external costs.

[20] Stavins (2000, p. 2) distinguishes three types of market barrier reductions. The first one, market creation, is a measure that facilitates the voluntary exchange of water rights and thus promotes more efficient allocation and use of scarce water supplies. The second type is information rules, such as energy-efficiency product labelling requirements. If these information rules are mandated, we can categories them within the traditional command-and-control policy. If they are not, e.g. if it is just to promote the adoption of environmental friendly technologies, we can categories them within voluntary measures. The third type, liability rules, will encourage firms to consider the potential environmental damages of their decisions.

[21] Subsidies can be structured in several ways. If the polluter is paid a certain amount for every unit by which its emission falls below a base level, the subsidy functions much like a pollution tax.

More specifically, a complete internalization by means of taxation can only succeed if there exists a system that generates not only accurate information on the external costs and the activities by which they are caused, but also on associated utilities, damages and marginal costs (Paulus, 1995, p. 27). Moreover, the environmental authority has to determine which part of total externalities has been caused by a particular pollution generating source. Paulus (1995, p. 28) points out that these requirements are never met in practice and concludes that Pigouvian taxes are more of a theoretical benchmark than an effective policy device. In practice, taxes may either fall short of curbing pollution or create excess burdens (Harberger, 1974). This excess burden that is put on citizens is one of the major problems of environmental taxation. According to Paulus (1995, pp. 58-59), tax avoidance will take place in the first phase, namely the perception phase, when the burden of the tax payment is directly experienced or felt by those who are confronted with the tax and if there are possible alternative ways of behaviour. In the second phase, the payment phase, those confronted with the tax payment will try to shift the burden of this payment to others. When this possibility is exhausted, those confronted with the tax will, in the longer run, be induced to search for further alternatives, i.e. environmentally friendly ways of behaviour. In the third phase, the incidence phase, when there are neither possibilities to avoid or reduce that which is taxed nor possibilities to shift the payment of the tax to others, those confronted with the tax will, ceteris paribus, adjust their behaviour in reaction to the lower income resulting from payment of the tax. Consequently, taxes put an excess burden on citizens as their income will decrease because of the payment they will have to make (Crals and Vereeck, 2004). As Backhaus (2002, p. 63) points out, the knowledge about the burden of taxation[22] is only available in the decentralized form of households, firms and other economic entities. It cannot be systematically collected by any central authority and for this reason the knowledge about the excess burden will be systematically underestimated by any conceivable attempt at measurement.

Paulus (1995, p. 28) following Burrows (1979) indicates that in situations with imperfect or poor information on policy instruments, governments have two policy options. First, the quest for socially efficient solutions can be pursued through iterative control (improvement little by little). In this sense, Pigouvian taxes that are set at too high or too low a level can be re-adjusted until an optimal tax rate is found. Important disadvantages of this procedure, however, are the uncertainty and the costs that are associated with trial-and-error re-adjustments. Instead of such a trial and error procedure, governments can also opt for the use of particular control policies to move the system towards pollution limits that do not claim to be socially efficient[23]. In this respect, given the fact that the Pigouvian tax

[22] This includes both the tax itself and the excess burden.
[23] These limits or standards, can, for instance, be set by politicians.

cannot serve as a practical policy device itself, second best approximates have been suggested of which the most familiar include the regulatory charge and the standard and charges approach[24].

Despite this fundamental flaw, environmental taxation has been put into effect in many countries under different forms. McMorran and Nellor (1994) distinguish between pure Pigouvian taxes levied on units of emission, indirect taxes on resources and consumption goods whose use cause ecological damage, and environmental provisions in other tax types like personal and corporate income taxes, general sales taxes or value added taxes[25]. The OECD (1996) uses five different categories:

- emission taxes[26],
- product charges when direct measurement of emissions is not possible,
- indirect (sales or value added) tax rate differentiation according to environmental friendliness,
- user charges[27], and
- income tax deductibles for environmentally friendly behavior by consumers or businesses.

Taxes typically carry both an incentive and financial effect. Although the purpose of Pigouvian taxation is to bring about a change in activity and pollution levels, environmental taxes can be easily conceived as just an alternative source of revenue for the government. Assuming a low treasury preference, public support may have to be won by an environmental tax reform that balances environmental tax revenues with tax cuts elsewhere or provides tax incentives for pollution reduction. However, this does not solve the systemic information problem. When environmental taxes are set too low, suboptimal emission reductions will result. Alternatively, high taxes will cause unwarranted deadweight losses. Moreover, it has been recognized that the mere existence of an externality does not in itself merit corrective state action. As mentioned, Coase (1960) convincingly argued that, under certain circumstances, the reduction of spill-over effects can be achieved via private negotiations. This insight has led to the development of a new policy instrument.

[24] These options are more in detail discussed by Paulus (1995).
[25] For example, lower VAT rates are applied in some countries to environmentally friendly products (e.g. recycled paper) or pollution reducing devices (e.g. solar energy equipment).
[26] Emissions taxes are usually only suitable for stationary sources because of their high monitoring and administrative costs.
[27] User charges are considered environmental tax instruments since they seek to reduce the use of natural resources such as water and land.

2.3.2. Tradable (emission) permits

Both in theory as in practice, tradable permits are a relatively new instrument. After Coase had showed that negotiations over externalities could lead to optimal outcomes if transaction costs are low and property rights, irrespective of the initial distribution,[28] well established, his insight soon found an application in emission permit trading. Crocker (1966) was the first to show that the Coase theorem could be applied to air pollution. He also correctly pointed out that, whereas effective Pigouvian taxation assumes perfect information about marginal external damages, a permit system requires no knowledge at all about damage or cost functions. The market will reveal marginal costs while the environmental authority only has to determine the *total* amount of pollution acceptable. Consequently, this approach fundamentally changes the information requirements imposed on the bureaucracy[29]. It remained for this key insight to become imbedded in a practical program for controlling pollution. While Crocker (1966) pointed out its applicability for air, Dales (1968) did the same for water. Furthermore, Dales (1968) claimed that transferable property rights could promote environmental protection at lower aggregate costs then conventional standards, for which Montgomery (1972) provided formal proof[30]. Locating externalities in the Arrow-Debreu model, Laffont (1988, p. 27) has argued that "in a regime of pure and perfect competition, externalities will be internalized naturally" because free entry to markets induces agents to acquire information on the externality. Hence, Laffont's formal analysis reflects the Coasean principle quite precisely.

Although transaction costs were not negligible, the concept of tradable emission rights was readily put into practice. Already in the seventies, the US Environment Protection Agency (EPA) started experimenting with various forms of permit trading as an instrument to control air emissions. The main issue was to find ways of avoiding a potential barrier on further industrial development in areas, chiefly in California, which were failing to

[28] The initial distribution of property rights is not a decisive factor in the Coasean world since trading of rights will assure that they are put to their optimal use.

[29] Crocker (1966, p. 81) stated that: "Although the atmospheric pollution control authority's responsibilities will continue to be a good deal broader than the basic governmental function of providing legal and tenure certainty in property rights, its necessary work will not have to include the guesswork involved in attempting to estimate individual emitter and receptor preference functions".

[30] Baumol and Oates (1971) already tried to prove the existence of a cost-effective permit market equilibrium but their results only apply in a special case, namely when all emissions from all emitters have to have the same impact on the environmental target. When the target involves meeting an ambient concentration standard, this case has become known as the 'uniformly mixed' case. The Baumol-Oates theorem is also valid when the environmental target is defined in terms of aggregate emissions. In many other cases, however, the location of the emissions does matter. Montgomery solved this problem by proving the existence of a different cost-effective permit market equilibrium in this more complicated case.

achieve the federal government's air quality targets because of the density and rising number of polluting activities[31] that accompanied strong economic growth. The idea that emerged was to continue to allow new industry to set up provided it made use of the most effective pollution control technology and could prove that the additional emissions that would ensue would be offset by a reduction in emissions from existing sources[32]. That gave rise to the offset system[33] (OECD, 2001, p. 11). With the economic repercussions of the 1974 oil shock, finding solutions which would lower the costs to business of complying with environmental regulations, without jeopardizing quality targets, also became of concern for the authorities of the United States. That led to the bubble system, pooling the requirements placed on all existing sources in a given facility, industrial zone or small region. A bubble permits higher emissions from some existing sources provided that they are offset by lower emission from others (OECD, 2001, p. 11). More recently, Title VI of the Clean Air Act Amendments set up the Acid Rain Program in which SO_2 emission rights are traded among electrical utility units (Atkinson and Tietenberg, 1991). This program has two very important innovative features. The first was to assure the availability of allowances by instituting an auction market. A second innovation was that it allowed anyone to purchase allowances (Tietenberg, 1999a). This program will be discussed more in detail in the fourth chapter. Several countries are currently in the process of planning or implementing trading schemes to reduce greenhouse gas (GHG) emissions (Woerdman, 2004). The principle rose to its current prominence by the Kyoto Protocol[34] which calls for international emissions' trading between 2008 en 2012 (Article 17). The Protocol has incorporated, besides the concept of emissions trading[35], three other provisions for cooperative implementation mechanisms, namely the bubble concept[36], joint implementation (JI)[37] and a

[31] For both stationary and mobile sources.

[32] This was accomplished by requiring new sources to secure credits for 120% of the emissions they would add; the extra 20% would be retired as an improvement in air quality (Tietenberg, 1999a).

[33] The offset policy requires major new or expanding sources in non-attainment areas to secure sufficient offsetting emission reductions from existing firms that the air is cleaner after their entry or expansion than before (Tietenberg, 1998).

[34] The principal accomplishment of the December 1997 Conference of Parties in Kyoto, Japan was the establishment of fixed quantitative reductions in greenhouse gases for 38 nations and the European Community. The reductions are expected to produce a global reduction of 5,2% from 1990 levels or 30% from levels that would have been expected by 2010 (Tietenberg, 1999a).

[35] The concept of emissions trading (Article 17) means that Annex B countries are allowed to purchase rights to emit greenhouse gases (GHG) from other Annex B countries that are able to cut GHG emission below their assigned amounts.

[36] The Kyoto Protocol incorporates the bubble concept into the final text of Article 4. It allows a group of Annex I countries to jointly fulfil their commitments under Article 3, provided that their total combined aggregate GHG emissions do not exceed their assigned amounts.

clean development mechanism (CDM)[38] (Tietenberg, 1999b, p. 2-3). To come into operation, the Kyoto Treaty needs to be ratified by at least 55 countries whose combined volume of GHG accounts for 55 % of emissions by industrialized countries (COM, 2000). Irrespectively,[39] the European Community (EC) adopted a directive that creates a trading program in GHG emissions rights for energy intensive industries *within* the EU (COM, 1995). Similar emissions trading schemes are already up and running in Denmark since 2001 and in the United Kingdom since 2002 (Woerdman, 2004).

2.3.3. Comparing tradable permits with environmental taxes

In principle, taxes and tradable permits exhibit a striking symmetry because for every tradable permit system that maximizes the value of the resource, an environmental tax exists that could achieve the same outcome. In practice, however, this symmetry disappears and striking differences can arise. Once a quantity limit is specified, the government has no responsibility for finding the right price in a tradable permit system; the market defines the price. With a tax system, the government must find the appropriate tax rate. Also with a tax system, the resource rents are normally channeled to the government while with tradable permits, resource users typically retain them. According to Tietenberg (2001a), recent work examining how the presence of preexisting distortions in the tax system affects the efficiency of the chosen instrument suggests that the ability to recycle the revenue (rather than give it to permit holders) can enhance the cost-effectiveness of the system by a large amount. Evidently, this work creates a bias toward taxes or auctioned permits and away from "grandfathered" permits[40]. How revenues are distributed, however, also affects the attractiveness of alternative approaches to environmental protection from the point of view of the various stakeholders. To the extent that stakeholders can influence policy choice, "grandfathering" may increase the feasibility of implementation[41].

The two systems are also quite differently if the government decides not to intervene in the market. While in a tradable permit system, inflation will merely result in higher permit prices; with taxes the amount of environmental protection will decline over time in the absence of some kind of indexing scheme. Conversely, technical progress that lowers compliance costs will result in more environmental protection under taxes than tradable permits (Tietenberg, 2001).

---

[37] This options involves project-oriented emission reduction credited to the investing country (allowed between Annex I countries).

[38] Countries that fund projects through the CDM can get credit for certified emission reductions (CER's) from these projects.

[39] In January 2005, 132 countries have ratified the Protocol, and their aggregate share in global emissions amounts to 61.6 %.

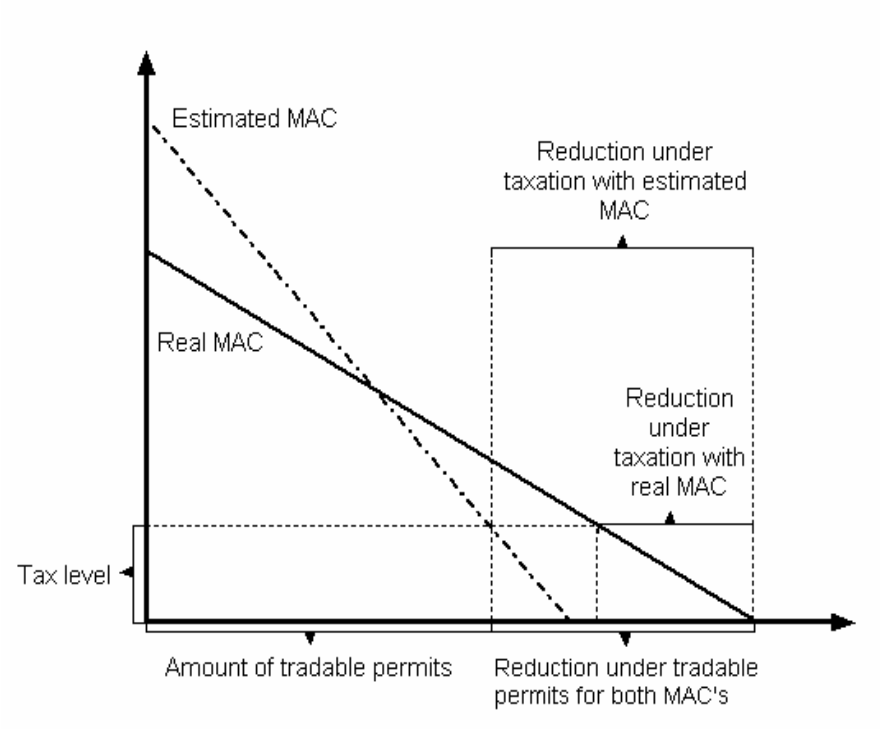
[40] The different forms of distributing permits will be discussed in the following chapter.

[41] Tietenberg (2001a) refers to Svendsen (1999).

Finally, the presence of uncertainty about the benefits and costs can lead to a preference of one instrument or the other depending upon the nature of the uncertainty[42]. For example, knowledge about the slope of the individual marginal abatement cost (MAC) curves is an important factor when setting the tax level (as already pointed out by Crocker (1966)). Figure 1 shows that, as market players pass on more incorrect information to the government about their marginal abatement cost curves, the advantage of a tradable permit system will increase at the expense of taxes, assuming that an autonomously determined environmental target needs to be fulfilled. Consequently, asymmetric information between the government and citizens or firms can lead to improper use of taxation. For example, citizens can declare higher marginal control costs than they really have (Johansson, 2000). If the marginal costs of pollution are not equalized, the costs of pollution control will be unnecessarily high (Kolstad, 2000, p. 141).

[42] Tietenberg (2001a) bases this assumption on work done by Weitzman (1974).

Figure 1: Certainty about the environmental result in spite of the uncertainty about the slope of the individual MAC-curves



Source: Based on Johansson (2000)

Concluding, this figure shows that taxes are only cost-effective when regulators are completely correct in their assessment of each person's control costs[43] and proofs that the presence of uncertainty, in the form of knowledge about individual MAC curves, leads to a preference of tradable permits (Crals and Vereeck, 2004).

2.4. Types of tradable permit systems

There exist four types of tradable emission permits systems:

- an averaging system,
- a usage rights system,
- a credit system, and
- a cap-and-trade system.

[43] However, as indicated by Ekelenkamp, Hötte and van der Vlies (2000, p. 69), it is almost impossible in practice for the policy makers to ensure that the marginal costs of pollution control are equalized among the different polluters generating the same pollution.

In an averaging program, the environmental authority sets an average emissions limit for similar products in the same industry. Firms are allowed to exceed this legal limit for some products when offset by other products they produce. Compensation among firms is also allowed. An averaging program is mandatory since the average environmental performance of the products in the range must comply with the regulatory requirements. Participation in trading with other companies, however, is voluntary. In general, excess emissions rights that are created through emissions reduction in averaging programs are seldom sold to competitors that did not achieve their emissions goals. Rather, they are used to create some headroom and flexibility within the company. Furthermore, averaging programs are aimed at large players with several products within the specified product range. This type of program is, therefore, not suitable for trading among many individuals[44].

A usage rights program aims to regulate the use of free and commonly owned resources (Crals, Keppens and Vereeck, 2004, p. 721). The rights are defined by a public authority or even a local community. The program is mandatory since the usage rights are binding for all parties[45].

Since the averaging system fails to promote trading between competing firms and usage rights have only limited application, only credit and cap-and-trade systems will be discussed.

A credit program imposes an emissions constraint on each *individual* resource user. Transferable emission reduction credits (ECR) can be gained by polluting less than the legal limit which is derived from existing environmental regulation or determined by expected future emissions[46]. In a cap-and-trade system, the environmental authority first determines the total amount of pollution (or cap) deemed acceptable and, subsequently, distributes fully tradable emission rights among resource users. The sum of those rights adds up to the cap[47].

Despite their apparent similarity, Tietenberg (2001a, p. 201) has argued that there are substantial differences between both approaches. A cap-and-trade system is characterized by the following features:

---

[44] An example is the CAFE (Corporate Average Fuel Economy) program that was set up to improve the fuel consumption efficiency of vehicles produced by US automobile manufacturers.

[45] There exist very few practical examples of a usage rights system. It is used in New Zealand for transferable fishing rights and transferable construction rights. No examples of usage rights in air pollution control exist.

[46] Credit trading, the approach taken in the bubble and offset policies, presumes the pre-existence of standards and provides a more flexible means of achieving the aggregate goals than the source-based standards were designed to achieve (Tietenberg, 1999a).

[47] Allowance trading is used in the Acid Rain Program and RECLAIM in California.

– Efficacy: the cap is a physical limit on emissions determined by the environmental authority which, by definition, guarantees that the system reaches its goal. The number of permits is limited accordingly and individual sources can only increase their emissions if they are compensated by pollution reductions elsewhere (Koutstaal and Nentjes, 1995).

– Flexibility: the environmental authority can set the legal cap at its discretion. In contrast with environmental regulation, polluters actually have a choice of either complying (by reducing production or installing abatement equipment) or purchasing additional permits.

– Dynamic efficiency: there is a clear incentive to reduce emission costs by investing in cleaner technology. Since excess permits can be sold, the system rewards participants who use cleaner technologies.

– Static efficiency: tradability assures that the emission rights will end up where they yield their highest value. In other words, trade will result in an efficient allocation of permits equalizing marginal abatement costs of polluters. However, this economic efficiency of the system is dependent on the relative ease of transferability of rights, viz. low transaction costs (Noll, 1981).

Since credit trading does not involve a cap, its effectiveness and efficiency is far less certain. First, polluters can simply comply with their legal environmental obligations without engaging in the trade of ECR which will reduce the liquidity of the market. As a result, prices for ECR may fail to reflect marginal external costs since they do not respond to variable emissions level as long as they remain below the legal standard (Dewees, 2000). Secondly, any increase in the number of resource users will lead to more pollution. It follows that the level of emissions allowed in a certain year can only be calculated accurately ex post (Woerdman, 2004). Furthermore, credit trading depends upon the existence of a previously determined set of regulatory standards while allowance trading does not. The practical implication is that allowances can be used even in circumstances: (1) where a technological baseline ether has not been, or cannot be, established or (2) where the reduction is short-lived (such as when a standard is met early) rather than permanent (Tietenberg, 1999a). Therefore, Tietenberg et al. (1999, p. 33) conclude that "allowance (*cap-and-trade*) trading programs have been proven superior to credit trading systems in terms of both economic and environmental results" (*it.add.*).[48]

The reason is essentially that credit trades are not of a commodity nature, with their higher transaction costs and with the regulatory barriers to their

[48] Nevertheless, many countries have relied on credit trading. Following Woerdman (2004), the social and political legitimacy of credit trading programs is due to their reliance on existing standards and the absence of any controversy on distributional justice.

creation. A cap-and-trade allowance program offers a system-based solution in which issues such as baseline, allowable levels and allocation are dealt with in the initial phase of establishing the overall program. After this initial phase, a cap-and-trade program can further function without the need for revising the issues for individual trades and therefore greatly reduces the need for government oversight. However, as Tietenberg et al. (1999, p. 33) highlight, if allowances are allocated to private entities, this initial phase can be contentious, as valuable economic rights are being allocated.

Credit trading, on the other hand, is project-based and requires all these issues to be analysed and verified for each trade. This means that each source must establish its emissions baseline, permitted level, reduction plan and enforcement mechanisms. Furthermore, this system requires a process of verification and government approval as well as continued monitoring. As a result, transaction costs and uncertainty are high. Tietenberg et al. (1999, p.33) compare allowances with a currency unit and credits with a specific good whose value must be determined each time through a regulatory process. They also conclude that one of the most important differences in these two types of trading programs is the level of government involvement in trading. Although allowance trading has very high quality assurance, once the program has been designed it requires no government involvement in approval of trades and consequently has lower transaction costs than credit trading which, in contrast, is project-based and requires one or more approvals for every trade, leading to higher transaction costs, uncertainty levels and risk, together with lower environmental quality assurance.

Despite the systemic flaws of ecological taxation and the qualities of cap-and-trade programs just described, the former is more often used. Opponents of tradable emission rights have unremittingly pointed at the prohibitively high transaction costs of the latter system allegedly as a consequence of its complexity.[49] We believe that this argument is false and rests on an inaccurate definition and incomplete classification of transaction costs as will be shown in the following chapters. Much depends on the policy setting in which environmental pollution occurs. Since Coase's 1960 article, it is not at all obvious whether an externality should lead to government action. Baumol and Oates (1988) have asserted that an active role by the government would be necessary when a large number of victims are concerned. The crucial difference between the Pigouvian and Coasean approach is whether the large number case is appropriate and, if so, whether or not large numbers of people are able to organize themselves.

[49] See e.g. Jackson (1995), Pearce (1995), Mullins and Baron (1997), Rao (2003, p. 158).

2.5. Controversy on tradable permits

The controversy on a tradable permits approach arises from several sources, but, according to Tietenberg (2001a, p. 197-198) the most important concerns the allocation of wealth associated with these resources. While tradable permits typically do not privatize the resources, as conventional wisdom might suggest, they do privatize at least to some degree access to those resources. And because the access rights can be very valuable when the resource is managed efficiently, the owners of these rights may acquire a substantial amount of wealth. The ability to reclaim that wealth for motivating sustainable behavior is an important strength of the system. However, the ethical issues raised by its distribution among competing claimants are a significant and continuing source of controversy.

Tietenberg (2001a, p. 198) distinguishes also another source of controversy, namely the broad class of externalities. In general, these are effects on the ecosystem or on other parties which are not or inadequately reflected in the decisions by those holding the access rights. This incomplete internalization of externalities could involve diverse adverse effects[50].

A final source of controversy that Tietenberg (2001a, p. 198) distinguishes is ideological. He suggests that "since capitalist property rights are the major source of the problem, it is inconceivable that these same rights could be part of the solution". For example, Goodin (1994) compares a tradable permits system to the sale of indulgences in the Middle Ages. Indulgences were granted by church officials, for a price, to sinners. Sinners could use them to remit time served in purgatory (Tietenberg, 2001b). According to Goodin (1994), economic incentive system approaches to environmental protections are morally suspect because they share with medieval indulgences several characteristics:

- the seller is selling something (the right to degrade the environment) that the seller has no right to sell;
- ethically, it can not be sold but only given away;
- it legitimizes and removes the stigma from acts of environmental degradation that are morally wrong, and
- it plays favorites, allowing some permit holders to do what none ought to be doing.

Tietenberg (2001b) states that the moral concerns that prevented the use of economic incentives policies can partially be overcome by a variety of measures that attempt to respond to at least some of the concerns:

[50] For example on the spatial concentrations of emissions.

– The supply of pollution permits is fixed[51] and is set on the basis of health and other physical considerations[52];

– Entitlements are defined in terms of a "limited authorization to emit" rather than conveying ownership of a portion of the airshed to private owners[53];

– In theory, a credit is a credit regardless of the circumstances of its creation, but in ethics some types of credit transfers are deemed more ethically justified than others. Emissions trading instead of credit trading responded to these ethical distinctions;

– The prohibition of trades that reduce air quality in specific neighborhoods even if they result in aggregate emission reductions and air quality remains betters than required by the ambient standards.

According to Tietenberg (2001b) following Roe (1998), all of these require an efficient penalty, but they may well increase the acceptability of the programs by reducing the potential for resistance. Designing programs to reduce resistance is apparently common in public policy.

With regard to the Kyoto Protocol, Woerdman (2002) has scrutinized the barriers why, although permit trading is the superior alternative according to economic literature, politicians are not accepting permit trading as the leading instrument for climate policy but mainly favor sub-optimal designs. He pays most attention to the political barriers of the instrument. The reason is that, when governments have accepted and decide to use such an instrument, it still has to be effectively implemented. However, Stavins (2002, p. 14-15) writes that although "…the political world has been slow to embrace the use of market-based instruments for environmental protection, (…) market based instruments have moved center stage, and policy debates look very different from the time when these ideas were characterized as 'licenses to pollute' or dismissed as completely impractical."

[51] Not subject to change in the face of higher prices.
[52] Not on the basis of willingness to pay.
[53] This addresses the concern that the airshed, which is seen as part of the common heritage, should not become private property.

3. Theory of tradable rights and transaction costs

3.1. Introduction

In the previous chapter it was argued that tradable permits outperform taxes because, whereas effective taxation assumes perfect information about marginal external damages, a permit system requires no knowledge al all about damage or cost functions. Consequently, the attention to use tradable permits for ecological purposes has steadily increased. However, opponents of tradable emission rights have unremittingly pointed at the prohibitively high transaction costs of the latter system allegedly as a consequence of its complex design.

The aim of this chapter is twofold. On the one hand, the purpose is to describe a theoretical framework of tradable permits in which all design issues are discussed (paragraph 3.2.). On the other hand, the purpose is to offer a transaction costs classification that is thought to include all relevant types of transaction costs (paragraph 3.3.). This scheme will be used for policy evaluation of tradable permits versus other policy instruments in the next chapters.

3.2. Theoretical framework

Cap-and-trade instruments are one set of tools within the broader set of market-based policy instruments as already discussed in the previous chapter. Moreover, research has shown that allowance trading has proven to be superior to other trading programs as also shown in the previous chapter. Therefore, we will focus on cap-and-trade instruments. Colby (2000, p. 639) distinguishes six different groups of stakeholders in a cap-and-trade market[54]:

- Direct resource users (interest in continued access, costs of access, profits and livelihood)[55];
- Environmental interests (interest in air & water quality, human and ecosystem health)[56];
- Policy makers (interest in balancing constituent interests, legal requirements and budgetary objectives)[57];

[54] The market consist of, according to Colby (2000, p. 639), the cap, the allocation of the rights, trading rules, monitoring and enforcement and the accountability for outcomes.
[55] For example: a fishing fleet, irrigators or electric utilities.
[56] For example: public agencies or NGO environmental advocates.
[57] Examples are state legislature, courts and administrative rule makers.

– Competing claimants (interest in access to resource and the costs of access)[58];

– Regulators (interest in effective implementation, avoiding political crossfire and an adequate budget), and;

– Economically linked businesses/communities (interest in jobs, economic viability and community stability).

Together, these disparate interests are faced with a complex and conflict-ridden task. Prior to the establishment of a tradable permits system, policymakers must determine how much of the resource can be used (cap), and with what exceptions for unusual conditions. They must assign initial allowances, set the rules for transfers, and monitor and enforce the activities that ensue. Finally, policymakers must account to stakeholders, the public and (sometimes) courts for the resulting stream of gains and losses. All these design issues will be discussed in the following paragraphs. It is important to note that the cap-and-trade implementation process can be obstructed at many points – from initial debate over whether a proposed cap on resource use is scientifically justified to fine-tuning the rules for reporting permit trades (Colby, 2000, p. 640).

3.2.1. Cap and trade

Cap-and-trade refers to a policy approach in which use of the resource is capped, use permits are allocated, and a permit trading mechanism is established (Colby, 2000, p. 639). When a resource is freely available and no conflict arises about its use, a system of tradable permits is unnecessary. However, once scarcity becomes evident, conflicts arise, and allocative mechanisms do become necessary. The cap-and-trade is best used when the problem is extensive over a large area, when there are many different sources that are responsible for the problem, when the costs of control differ from source to source and when emissions can be measured in a consistent and correct way. In the case of fishery, e.g., the cap could be set based on the total amount allowed catching. For pollution, the cap is typically set based on the aggregate amount of emissions allowed. Consequently, the cap defines the aggregate level of access to the source that is authorized. A system of cap-and-trade gives the highest certainty that an (efficient) reduction is achieved, also in times of economic insecurity. For example, in order to emit a given quantity of pollutants, a source has to have the appropriate number of permits. If a source wants to increase emissions, it has to obtain additional permits for its emissions (Ermoliev, Michalevich and Nentjes, 2000, p. 39).

[58] These are e.g. the new entrants into the market.

A precondition for the establishment of a market is a definition of the tradable right. Economists have consistently argued that these permits should be treated as secure property rights to protect the incentive in pollution control equipment. Confiscation of rights could undermine the entire process (Tietenberg, 1999a). Following Tietenberg, the environmental community has just as consistently argued that the air belongs to the people and it, as a matter of ethics, should not become private property. According to this view, the ends cannot justify the transfer of a communal right into a private one. For instance, the right to a reasonable level of clean air is seen as inalienable. The practical solution of this matter, according to the Clean Air Act, involves providing some security to the permit holders, while making it clear that it is not a property right. In practice, this means that policy makers are expected to recognize the security needed to protect control investments. However, their ability to change control requirements as the need arises will not be inhibited by the need to pay compensation for withdrawing a portion of the authorization to emit (Tietenberg, 1999a).

3.2.2. Initial distribution of the permits

The initial distribution of the permits is one of the most complex issues in the design of a cap-and-trade system. In the literature, we find 3 main categories of distributing permits amongst entities, namely: allocation by lottery, an auction or allocation by criteria. In the first case, permits are allocated randomly. A reliance on lotteries is usually motivated by a desire to provide an equal possibility of access to all potential claimants. This approach is used e.g. when allocating a limited number of permits to hunt moose in Maine (Tietenberg, 2001b). However, due to its relative lack of importance in pollution control, we shall not discuss this option any further.

Lyon (1986) has examined the theoretical consequences of various initial allocation methods. In general, he discovers that, in the long run, regardless of whether permits are allocated by auction or by criteria, the ultimate allocation of control responsibility will be the same. The reason for this result is that allowing tradability in purely competitive markets assures that the permits ultimately end up with to those parties who value them the most regardless of the initial allocation (Tietenberg, 2001b). This is an important supposition which provides a lot of flexibility to policy makers. However, while these results demonstrate that the ultimate allocation of control responsibility may be insensitive to the initial allocation of permits they do not imply the same distribution of costs. Auctions typically involve transfers of resources to the government, whereas allocations by criteria do not.

3.2.2.1. An auction

In an auction, the fixed number of permits will be allocated to the highest bidder. Several possible types of auctions exist (Cramton and Kerr, 2002):

- Sealed-bid auctions;

- Ascending auctions; and
- Ascending-clock auctions.

In sealed-bid auctions, the bidders simultaneously submit demand schedules. The auctioneer adds these demand schedules to form the aggregate demand curve. The point at which the aggregate demand curve and the supply curve cross determines the clearing price[59] (Cramton and Kerr, 2002). Disadvantage of this system is that bidders need to know their personal demand curve. Furthermore, the system is subject to strategic bidding and bidders can not adjust their bid in function of that of others (Bernheim, 2001, p. 80). In an ascending auction, both price and allocation are determined through a process of open competition. Each bidder has every opportunity to improve (raise) its bids, changing losing bids into winning bids. In the end, those willing to pay the most win the permits. Finally, in an ascending-clock auction the clock indicates the current price. In each round, the bidders submit the quantity they are willing to buy at that price. If the total quantity bid exceeds the quantity available the clock is increased. The bidding continues until the quantity bid is less than the quantity available. The permits are then allocated at the prior price, and are rationed for those that reduced their quantity in the last round[60].

From an economic perspective, auctioning is optimal because permits are allocated to those who yield them the highest value. Consequently, permits are efficiently distributed. Furthermore, there is a free entrance for new market members. All participants are being treated equally meaning that both newcomers and already existing participants have to buy permits. Historical use of emissions, therefore, has no influence and newcomers have no competition disadvantage to enter the market. Auctioning off permits also provides a reference price and this can help to start up trade in a later phase. Trough this indicative value of the permits, participants can more easily determine their strategy and decide how much rights they need to cover the projected use and consequently bid for these rights on the auction. Revenue raising methods, such as auctioning, can also help reduce the tendency of existing factor-market distortions to be intensified by pollution

[59] The two most common pricing methods are uniform pricing and pay-your-bid pricing. Under uniform pricing, each winner pays the clearing price for each permit. With pay-your-bid pricing, each winner pays its bid. Of course, bidding behaviour is quite different under the two approaches as described by Cramton and Kerr (2002). With pay-your-bid pricing, the bidder attempts to guess where the clearing price is likely to fall and then bids slightly above it. With uniform pricing, predicting the clearing price is less important, since every winner pays the clearing price regardless of how high it bids.

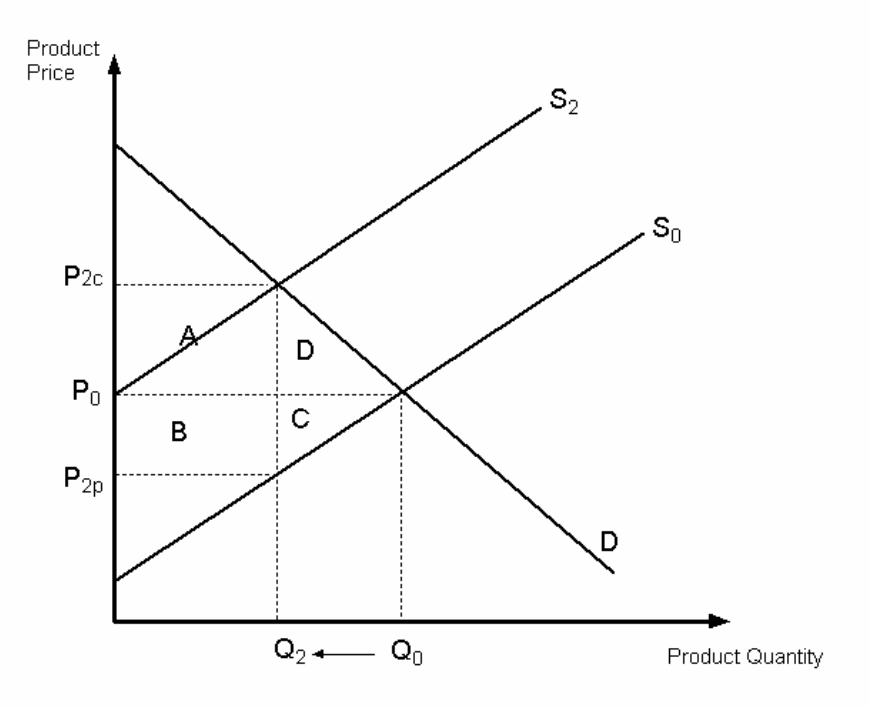
[60] Some advantages of this system are: (1) it is easier to implement for both seller and buyers, since a buyer only bids a single quantity in each round; (2) there is no possibility of undesirable bid signalling, since only the total quantity bid is reported and (3) rapid convergence is guaranteed, since the price increases by one bid increment with each round of bidding (Cramton and Kerr, 2002).

control policy, providing the revenue is used for this specific purpose[61] (Tietenberg, 2001b). There are, however, also some disadvantages when auctioning off permits of which the most important is the large financial burden on sources. Furthermore, with auctioning, polluters can end up in an inferior competitive position compared with foreign competitors who are not subject to a similar system (Bernheim, 2001, p. 81). Also, since the financing capacities of polluters are very different, a suboptimal distribution of the efforts can come about. The wealthy polluters can buy more easily permits than others. This is an actual risk when introducing tradable permits because great purchasing power differences can exist between participating entities. Finally, the effects of an emissions trading program on a product market, assuming that the initial allowances are auctioned, are shown in figure 2. The demand and initial supply curves are noted as D and S_0. The second supply curve, S_2, reflects the costs of the auctioned permits, ignoring for this illustration the effects of the changed cost of producing the product in order to focus on the effects of auctioning[62]. The shift in supply due to the auctioned allowances result in an increase in the price of the product to consumers, from P_0 to P_{2c}, and reduction in the quantity produced from Q_0 to Q_2. The labelled areas in the figure illustrate how auctioning allowances affects owners of existing facilities and the loss in consumer surplus (indicated by A and D). With the rise in prices and reduction in sales, the value of the capital assets held by facility owners is reduced, because the producer surplus they generate has declined by the amount illustrated in the figure (B and C is the lost producer equity).

[61] Auction revenue can replace distortionary taxes which create deadweight loss by inserting a wedge between marginal cost and price. As described by Cramton and Kerr (2002), the rents in an auctioned system are collected as revenue by the government. This revenue could be used to cut labor, payroll, capital, or consumption taxes or to reduce the deficit, all of which would create efficiency gains.

[62] From this perspective, permits can be seen as another factor of production.

Figure 2: Product market effects of auctioned distribution



Source: Harrison and Radov, 2002, p. 22

3.2.2.2. Allocation by criteria

The most common allocation by criteria is grandfathering the permits. Grandfathering refers to an approach that bases the initial allocation on historic use. Under grandfathering, existing sources only have to purchase any additional permits they may need over and above the initial allocation (as opposed to purchasing all permits in an auction market). Policy makers distributed permits for free among market players and therefore have a complete influence on the composition of the market. Consequently, it is relatively easy to prevent unwanted monopolies. The most important advantage of grandfathering is that the excess costs incurred by participants can be kept low[63]. The financial efforts are limited to the purchase of rights in excess of the free permits or the adaptation investments which are done to stay within the permit allocation. An important result of the economic theory of permit trading is that the marginal costs under grandfathering are identical to the marginal costs under an auction. The reason is that the freely assigned allowances have an opportunity cost associated with them: participants that receive allowances can sell them to others (Harrison and Radov, 2002, p. 23). Because the marginal costs are the same, economic theory predicts that resulting control decisions by individual facilities will be identical to the decisions that would be made under an allowance auction,

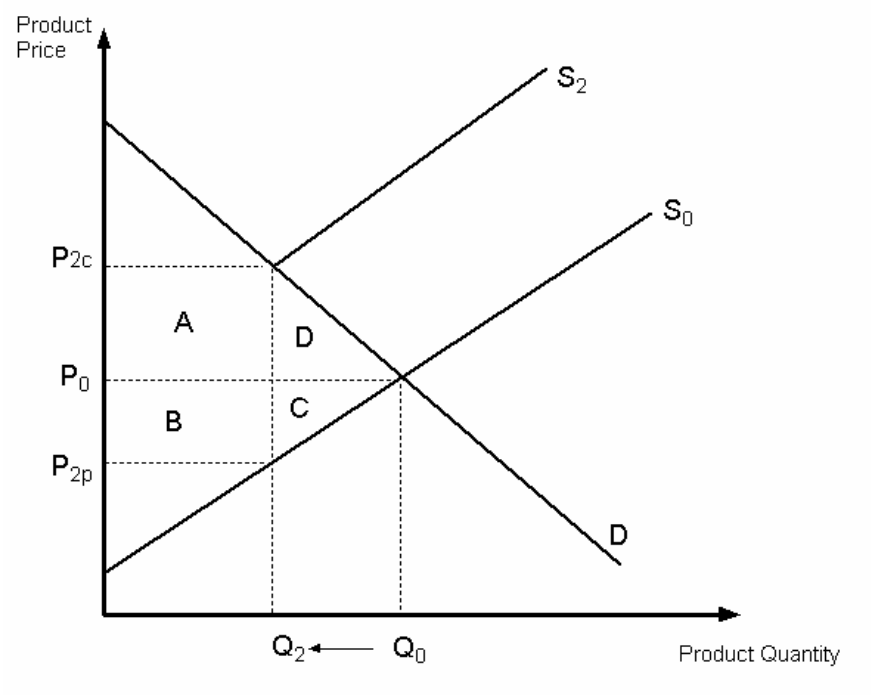
[63] Participants receive a so-called windfall profit.

as already pointed out. However, when grandfathering permits existing participants will be more willing to accept the system because they receive 'free' rights. Grandfathering is based on the principle of acquired rights of the polluters, just as the first owners of land, on a specific moment, have obtained the right of ownership (Bernheim, 2001, p. 78). Although politically the easiest path to sell[64], grandfathering has also its disadvantages. Namely, it is possible to reserve some permits for new participants but this option is rarely exercised in practice. As a result of the free distribution scheme, new participants typically have to purchase all permits, while existing participants get an initial allocation fee. Thus, the free distribution based on historical use imposes a bias against new users in the sense that their financial burdens are greater than that of identical existing users (Tietenberg, 2001a, p. 206). Furthermore, the practice of grandfathering can actually increase pollution in the short run if sources are aware that larger current use results in larger future permits allocations. Naturally, as described by Tietenberg (2001b), this can create an incentive to elevate current emissions for the purpose of qualifying for a large initial allocation of permits. This problem can be circumvented by basing the initial allocation on the command-and-control authorized (as opposed to actual) emissions. That way, increasing actual emissions in this system does not increase permit allocations. As with auctioning off permits, grandfathering can intervene with the competitive position of specific participants. Free distributing permits can be seen as a subsidy, which has certain implications for the competitiveness of a country, sector or individual company. Therefore, when allocating permits, the European competition rules[65] and those of the World Trade Organization need to be taken into account.

Figure 3 shows the case in which allowances are grandfathered. The negative effects on the sector are clearly lower than under the auctioning; although the sector must control e.g. emissions to the same degree, under grandfathering producers receive allowances. In this example, the total asset value of owners' facilities in the sector actually increases under grandfathering, by the amount represented by the area A - C[66].

[64] This political acceptability arises from the fact that with a grandfathering system, existing sources can be no worse off than they were with the command-and-control system, but they might be better off. Since existing sources will have the same initial allocation under both systems, the choice not to trade makes the firm equally well off. On the other hand, those existing sources that do voluntarily trade are unambiguously better off (Tietenberg, 2001b).
[65] EG-treaty art. 92 and 93.
[66] The net producer gain (A-C) = permit allocation (A+B) – lost producer equity (B+C).

Figure 3: Product market effects of grandfathered distribution



Source: Harrison and Radov, 2002, p. 24.

Besides grandfathering, another criterion that is described in the literature is updating. The updating approach bases future allocations on a facility's current and future activities. For example, if the updating formula is based on production, a facility's allocation in 2010 may depend upon its output in 2008. This approach clearly would provide an incentive to increase output in 2008 in order to receive more allowances in 2010 (Harrison and Radov, 2002, p. 25)[67]. Using updating for the initial allocation of permits looses one of the most important features of permit trading; because participants receive more permits if they use more, they will be tend to increase their use and hence get a higher allocation. Thus, this incentive to increase production is directly at odds with one of the most important control options – namely the reduction in generation. The economy as a whole will be worse off under updating. Because firms are producing more output than they would in the non-updating cases, they are forced to implement more stringent, more expensive controls to maintain the cap. As a result, the demand for allowances rises compared to the demand under either auctioning or grandfathering. The net result is higher compliance costs to achieve the same emissions target. Concluding, the new mix of compliance choices

[67] Updating is related in certain respects to an emissions allocation based on relative targets. If relative targets are used, firms are allocated emissions allowances based on an industry-wide emission rate – often expressed in tons per unit of output. Relative targets are equivalent to averaging programs, rather than cap-and-trade programs.

under updating would not minimise the overall cost of meeting the emissions cap, which would result in distortions in both the allowance and product markets. Compared to either grandfathering or an auction mechanism, the allowance price would be higher and economy-wide economic output would be lower because of the misallocation of resources (Harrison and Radov, 2002, p. 30).

3.2.3. Transferability rules

A big source of controversy is attached to the rules that govern the transferability of permits. Following Tietenberg (2001a), transferability not only assures that rights flow to their highest valued use[68] and restrictions on that transferability only serve to reduce the efficiency of the system, but it also provides a user-financed form of compensation for those who voluntarily decide to no longer use the resource. However, according to critics, allowing the rights to be transferable produces a number of socially unacceptable outcomes including the concentration of rights, the destruction of community interests and the degrading of traditional relationships among users as well as the environment. One of the most important fears that is expressed in almost any discussion of tradable permits involves the degree of market power that can be facilitated by the tradability.

The first type of market power involves the ability of participants to manipulate prices strategically in the permit market either as a monopolistic seller or a monopolistic buyer. Hahn (1984, p. 763) has examined the possibility of market power with transferable property rights. He states that, just because a firm may have a large share of the permits, this does not necessarily mean it can influence the outcome in the permit market. Furthermore, if a firm does have market power in the permit market, its effect on price (assuming that there is one firm with market power) varies with its excess demand for permits. Therefore, once the potential for market power has been ascertained, it is a flow – excess demand of the firm with market power – which determines the equilibrium. According to Hahn (1984), the importance of the flow has immediate implications for the market design. In particular, with full knowledge of demand functions, a central authority could effectively pick the quantity of permits it wanted the dominant firm to use through a suitable initial allocation. Of course, the more realistic situation is one in which the authority has, at most, only a crude estimation of the demand functions. In this case, Hahn proposes a

[68] Trading allowances enables participants operating at high marginal abatement costs to purchase additional allowances from participants operating at lower marginal abatement costs. this provides a means of compensating participants with relatively lower marginal abatement costs for assuming a relatively greater share of the costs of reductions. The lower cost participants are expected to expand their abatement efforts until their marginal costs rise to meet those of higher cost firms (Burtraw and Mansur, 1999).

basic model[69] that can be applied to assess the possibilities for exerting market influence. Tietenberg (2001b) has also studied market power and his analysis supports the notion that market power on the seller side is a more serious problem than market power on the buyer side. He uses transaction costs for the basis of this assumption. Because transaction costs associated with forming a cartel with a large number of small sources are significantly greater than those for forming one with a small number of large sources, proportional initial allocation rules make power on the seller side more likely than on the buyer side by creating a situation involving a few plants selling permits to a much larger number of buyers.

However, strategic price behavior is not the only potential source of market power problems. Firms could also conceivably use market permits as a vehicle for driving competitors out of business. However, this problem is relatively rare. In most markets, permits represent a very rude instrument for attempting to gain a strategic advantage (Tietenberg, 2001a and 2001b).

In conclusion we can say that, even when the possibility of market power exists, the consequences can frequently be limited by proper program design. A first option is an auction market which provides a continuous source of permits, thereby limiting the ability of one participant or group of participants from cornering the market. Furthermore, the government can also set aside some permits which they can sell should the need rise. Broer, Mulder and Vromans (2002, p. 29) state that there is a need for sufficient suppliers and buyers for the well functioning of the market and preventing market power. The more market players, and the more they differ in abatement costs, to more reason they have to trade. The existence of easy possibilities to enter the market will also improve competition on the permit market.

3.2.4. Temporal dimension

Standard theory suggests that a value maximizing tradable permit system must have temporal exchangeability, thus implying that allowances can be both borrowed and banked[70]. As argued by Rubin (1996, p. 281), perhaps the most important consequence of emissions banking and borrowing is the ability to firms to shift their emission stream through time. Banking allows a user to store its permits for future use. With banking, for example, a resource user can save unused permits from 2001 for use in 2004. Banking is thought to give opportunities for cost savings by affording firms flexibility in timing their investment for compliance. With the opportunity to bank unused allowances, a firm may decide to invest in a relatively grater

[69] A critical assumption underlying the competitive model is that firms act as if they were price takers. In the model developed by Hahn, it is assumed that all firms except on are price takers. This model is in detail discussed in Hahn (1984).
[70] Tietenberg (2001a) refers to Rubin (1996) and Kling and Rubin (1997).

level of abatement in a first period and consequently create an allowance surplus that can be used to delay further investments in a later period (Burtraw and Mansur, 1999). When banking is not allowed, 2001 permits are only valid in 2001. With borrowing, a permit holder can use permits earlier than their stipulated date. For example, permits holders can choose to use 2004 permits in 2001, but that means of course that they are no longer available in 2004. Rubin (1996, p. 281) has shown in his paper that, because the society is becoming increasingly concerned with environmental quality and emission standards are becoming more stringent, banking of emission permits can lower social damages. Banking also provides cost savings to firms by allowing them to adjust their own internal rates of emission reductions to an externally set standard. According to him, banking can, along with averaging[71] and trading[72], lower the financial costs of compliance. Therefore, he concludes that, along with averaging and trading, banking should be considered by public policymakers in charge of ensuring the safety of the environment. Kling and Rubin (1997) have investigated, using a simple optimal control model, the firms' incentives for banking or borrowing emission permits and compares the emission and output streams firms would chose within the socially optimal solution. They find that in many cases firms will sub-optimally choose excessive damage and output levels in early periods and correspondingly too few in later periods if given the opportunity to freely move emissions between time periods. They propose a modified banking scheme where firms are not allowed one-to-one trades of emissions between time periods; instead emissions borrowed against future savings are penalized by the rate of discount[73] (Kling and Rubin, 1997, p.111).

There also some disadvantages when granting temporal flexibility to participants (Tietenberg, 2001a). The first one involves the potential for creating a temporal clustering of emissions. With complete freedom on their temporal use, it is possible for resource users to be concentrated in time. Since concentrated resource use causes more degradation than dispersed use, regulators have chosen to put a priori restrictions on the temporal use of permits despite the economic penalty that imposes. The second concern has arisen where imposing sanctions for noncompliance is difficult. It has been noted that enforcing the cumulative emissions budget on a nation that has borrowed heavily in the earlier years would become increasingly difficult over time (Tietenberg et al., 1999). Borrowing also puts the environmental cap at risk because participants can keep on borrowing permits without ever reaching their limit.

[71] For example, emission averaging between sources within a firm.
[72] He refers here to trading between firms while banking and borrowing refer to trading through time.
[73] This means that the firm would be required to pay back more emissions than it used.

The length of validity is a determining element in the possibility to make efficiency gains using trading. The tradability of a permit becomes more difficult when its length of validity is smaller. With a limited length of validity, efficiency is more likely to be reached by the initial distribution than by the trade. Furthermore, a limited length of validity increases the transaction costs of the government and market players because these are partly connected with the frequency of repeating the initial distribution of the permits. However, there are also disadvantages against rights with long lengths of validity. First of all, the insecurity about the price development can negatively influence the revenues of auctioning off permits[74]. Secondly, the market will function worse when the policy lines are not available or not known at the moment that the government determines the cap. However, deciding on explicit policy lines for a long period reduces the margin of the government. Finally, permits with a long length of validity hamper the possibility of adjusting the policy by the government[75] (Broer, Mulder and Vromans, 2002, p. 25).

3.2.5. Geographical area

In general, a larger geographical area implies more market players and therefore a better tradability of the rights. Consequently, a smaller geographical area can imply less market players and therefore less efficiency gains. Furthermore, a smaller geographical can also induce participants to move and hence evade the system[76] (Broer, Mulder and Vromans, 2002, p. 30). When determining the geographical area, the link between the area and location, where the external effects manifest, needs to be taken into account. For example, there exist two possibilities when dealing with pollution:

- the emissions of different locations have the same effect, in other words, they are not location bound;
- the emission are location bound[77].

Tietenberg (2001b) distinguishes three different approaches: (1) emission permits, (2) zonal systems, and (3) trading rules and trading ratios. These different approaches are discussed in detail by Tietenberg (2001b) and we will merely give the most important characteristics.

The first one, emission permits, ignores source location and controls only emission levels. However, to reach a concentration target is often

[74] Hence, the revenues can turn out to be lower than the value in cash of an annual auction.
[75] However, the government can still adjust the cap by buying rights on the market or deciding that each permit give right to e.g. a lower amount of emissions than in the preceding period.
[76] This is called leakage and occurs when companies move their production to places where emission trading is not used.
[77] Here it is very important to find the appropriate geographical area.

suboptimal; it can exact a cost penalty and can bring about hot spots[78]. The evidence on the size of the potential cost penalty when emission permit systems are used to control non-uniformly mixed assimilative pollutants from multiple sources for multiple receptor sights is mixed. Tietenberg (2001b) refers to the ratio of emission permit regional control costs to the traditional command-and-control policy. A ratio of greater than 1.0 indicates that the emission permit approach achieves the objective at lower cost while a ratio of less than 1.0 indicates that the traditional regulatory approach is cheaper. Since the ratios in this analysis range from a low of 0.42 to a high of 11.10, the cost-effectiveness of an emission permit system in this context is apparently quite sensitive to local conditions.

Emission permits give also rise to the concern of hot spots because they are caused both by the amount of emissions[79] and by their location and timing[80]. Emission permits may increase the threat of hot spots in two main ways. First, trades may create unacceptably high local concentrations near sources that have acquired permits as an alternative to further control. Second, permits may allow the long-range transport of emissions to increase, thereby increasing deposition problems.

The second one, zonal permit systems, deal with the spatial dimension by dividing the control area into a grid containing a specific number of zones (Tietenberg, 2001b). In the most restrictive of this approach, trades would be allowed within zones, but not between zones. In less restrictive versions, trades between zones are allowed using predefined trading ratios. Zonal approaches have a certain appeal because they appear to provide a middle ground between the excessive simplicity of emissions-based policies and the excessive administrative complexity associated with tailoring the instrument design to the unique circumstances of each emitter. Whereas emissions-based systems normally over control distant sources, the zoned system allows differential treatment of distant and proximate sources. Whereas an emission-based system is vulnerable to the creation of hot spots, the zoned systems appears to lower this vulnerability by targeting greater control on those zones containing the emitters which are the main contributors to the most severely affected receptors. However, the implementation of a zonal system places a larger burden on the control authority than the implementation of a pure emission permits system. With the zonal permit system, the control authority has to define a vector[81] rather than the scalar[82]

[78] Hot spots are unacceptably high concentrations of pollutions in particular locations; emission permits could contribute to the formation of hot spots if they allowed more clustering of emissions in vulnerable areas than permitted under command-and-control.
[79] The amount of emission is controlled by emission permits because a cap is determined.
[80] These are not controlled by emission permits.
[81] The vector contains the elements corresponding to the level of authorized emissions in each zone.
[82] The scalar is the aggregate emissions level.

that is necessary to implement an emission permit system (Tietenberg, 2001b).

The final option when a tradable permit approach is used is firstly ruling out certain classes of trades, while allowing others and secondly allowing the permits to be traded at something other than a one-for-one ratio without imposing zonal boundaries or predetermined fixed exchange rates. Both of these possibilities represent a departure of the two former approaches but they focus on the transaction and not at the market as a whole. In practice, however, as indicated by Tietenberg (2001b), manipulating trading ratios can extract an efficiency penalty and can have ambiguous effects on trading activity and air quality. The alternative, allowing one-for-one trades and retaining the right to prohibit specific trades that represent problems, seems to be the most common choice of policy makers.

3.2.6. Monitoring and enforcement

The attainment of economic, social and environmental objectives is mostly dependent on the monitoring and enforcement issues. Non-compliance not only makes it more difficult to reach stated goals, it sometimes makes it more difficult to know whether the goals are being met. Tradable permit systems raise certain monitoring and enforcement issues especially because it offers the possibility of raising income levels for participants. This possibility will also raise the incentives for non-compliance. Therefore, in the absence of a strong enforcement system, illegal activity can occur together with a failure of meeting the cap (Tietenberg, 2001a).

3.2.6.1. Monitoring

As pointed out by Stranlund and Dhanda (1999, p. 267), Malik (1990) appears to be the first to cast doubt on the efficiency properties of transferable permit systems when firms may be noncompliant. In a comparison of a transferable permit system to uniform emissions standards with exogenous enforcement, Keeler (1991) finds that non-compliance (and hence, aggregate emissions) may be greater under a transferable permit system than under uniform standards. In another comparison of a transferable permit system to a uniform emissions standard, but this time when enforcement expenditures are committed to achieve a certain degree of compliance, Malik (1992) finds that a transferable permit system may be more costly to enforce, and hence, enforcement plus aggregate abatement costs may actually be higher for such systems than for uniform emissions standards. Laffont and Tirole (1996) have analysed the impact of spot and future markets for tradable pollution permits on the potential polluter's compliance decisions. Polluters have different possibilities: they can buy permits, invest in pollution abatement, or stop production or source out. In

their analysis it is shown that stand-alone spot markets[83] induce excessive investment. The introduction of a futures market[84] reduces this incentive to invest, but is not the optimal way to control pollution. They propose a menu of options on pollution rights, possibly coupled with intertemporally bundled sales that will yield higher welfare.

In practice, every monitoring system must identify both the information that is needed to monitor the operation of the tradable permit program and the management component that will gather, interpret, and act on this information. Data should also be collected on transfers so that monitoring and analysis of the market can take place. Therefore, effective monitoring systems are composed of data, data management, and verification components (Tietenberg, 2001a). In general, there are two different kinds of monitoring data required for the smooth implementation of a tradable permit program. Firstly, periodic data on the condition of the resource is needed to evaluate the effectiveness of the program. These data are also used for adjusting the cap. Secondly, sufficient data is needed to monitor compliance with the various limitations imposed by the regulatory system. Furthermore, for the monitoring of compliance with a tradable permit program data is required on the identity of permit holders, the amount of permits owned by each holder and permit transfers. As Tietenberg (2001a) suggests, one key to a smoothly implemented tradable program is ensuring that all data needed are input into an integrated computer system that is accessible by eligible users on a real-time basis. Facilitating this kind of flexibility would reduce the enforcement burden considerably. It also proofs that technology plays a very important role in tradable permit programs because it ensures administrative efficiency, lowers transaction costs and provides greater environmental accountability.

Finally, monitoring of a tradable permit system can occur on different levels. In an upstream design, the monitoring is organised at the level of the producers and importers while in a downstream design, the monitoring is focused on the end-users. There are significant differences between the number and type of market actors who have to be monitored under an upstream and a downstream design. An upstream design will have far fewer and much bigger actors than a downstream design. In terms of the impact on administrative efficiency, fewer actors in an upstream monitoring design will be easier to manage while downstream monitoring has the potential to become impractical, with potentially a large number of actors, leading to

[83] In a stand-alone spot market, the regulator does not observe investments but his only instrument is the supply of pollution rights each period. Thus, the government sets at the beginning of each period the number of permits for that period.

[84] In a futures market, the regulator also does not observe investments but he can offer in the first period pollution rights for the second period with the commitment of not changing the supply of pollution rights in the second period.

high administration costs (Crals, Keppens and Vereeck, 2004, p. 133). An option proposed by Haites and Mullins (2001, p. 38) is a hybrid system; for example upstream compliance with allocations to upstream and downstream entities or a downstream trading program for large sources and efficiency standards for smaller entities. The result of all these possibilities is an implicit trade-off between administrative efficiency (the number of actors to be monitored) and economic efficiency (the more actors, the more cost savings the system brings).

3.2.6.2. Enforcement

The literature on optimal regulatory enforcement begins with Becker (1968), who pointed out that because enforcement is costly, it is not socially optimal to identify non-compliant agents all the time but rather do so sporadically and raise sanctions to the maximum feasible level. Building upon this literature, Montero (2002, p. 436) has studied whether incomplete enforcement of a regulation has any impact on the choice between price (e.g. taxes) and quantity (e.g. tradable permits) instruments. He finds that, under cost and benefit uncertainty as well as incomplete enforcement, a quantity instrument performs relatively better than a price instrument. In fact, if the slopes of the marginal benefit and marginal cost curves are the same, the quantity instrument should be preferred. The reason is that in a quantity regime with incomplete enforcement, the effective (or observed) amount of control is no longer fixed, but rather endogenously determined by the actual (ex-post) cost of control (Montero, 2002, p. 452-453). Stranlund and Chavez (2000, p. 128) have shown in their analysis that a self-reporting can conserve monitoring costs, not because it allows for targeted monitoring as in the context of enforcing emissions standards, but because it allows the application of a penalty for a reporting violation that serves as an additional deterrent to non-compliance. In addition, they have also shown (p. 126) that targeted monitoring, i.e. the practice of monitoring some firms more closely than others, is not necessary in a competitive permit system. Finally, they suggest (p. 127-128) tying penalties in transferable permit systems to the current equilibrium price of permits. According to them, doing so would allow enforcement authorities to choose a monitoring strategy that is effective, yet independent of permit market fluctuations. Tietenberg (2001a) argues that a successful enforcement program requires a carefully constructed set of sanctions for non-compliance. Penalties should be commensurate with the danger posed by non-compliance. Penalties that are unrealistically high may be counterproductive if authorities are reluctant to impose them and participants are aware of this reluctance. Unrealistically high penalties are also likely to consume excessive enforcement resources as those served with penalties will seek redress through appeal processes. In practice, predetermined administrative fines can be imposed by the enforcing agency itself for “routine” non-compliance. In an ideal system, more serious non-compliance in terms of either the magnitude of the offence

or the number of offences would trigger civil penalties. Criminal penalties should be reserved for falsification of official reports and the most serious violations.

3.3. Transaction costs

3.3.1. Survey of the literature

The concept of transaction costs was introduced by Coase (1937) to explain why firms exist as an alternative for organizing economic activity by means of exchange transactions across the market. The answer is that firms arise because there are substantial costs involved in using the market. Coase was not very explicit about what he meant by these transaction costs. He described them as the cost of "discovering what the relevant prices are" (p. 390) or "negotiating and contracting costs" (p. 391).

Arguably, transaction cost reasoning became most widely known by Oliver Williamson (1979). He defined them as "the economic equivalent of friction in physical systems" (1985, p. 19). Arrow has referred to transaction costs as "the costs of running the economic system" (1969, p. 48). Eggertson (1990) and Barzel (1997) associate transaction costs with the transfer, capture, and protection of exclusive property rights[85].
Coase himself later clarified that "to carry out a market transaction, it is necessary to discover who it is that one whishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading op to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed and so on" (1960, p. 15). Under such broad definition, transaction costs include all costs associated with any allocative decision including the costs of uncertainty with respect to the outcome of the decision (Challen, 2000). Stavins (1995) has claimed that transaction costs are "ubiquitous" in market economies since parties must find one another to transfer, communicate and exchange information. At the extreme, North (1990) considers transaction costs as just part of production costs, thus expanding the neoclassical definition.

[85] Eggertsson (1990, p. 14-15) continues: "When information is costly, various activities related to the exchange of property rights between individuals give rise to transaction costs. These activities include: (1) the search for information about the distribution of price and quality of commodities and labour inputs, and the search for potential buyers and sellers and for relevant information about their behaviour and circumstances; (2) the bargaining that is needed tot find the true position of buyers and sellers when prices are endogenous; (3) the making of a contract; (4) the monitoring of contractual partners to see whether they abide by the forms of the contract; (5) the enforcement of a contract and the collection of damages when partners fail to observe their contractual obligations; and (6) the protection of property rights against third-party encroachment – for example protection against pirates or even against the government in the case of illegitimate trade".

Furubotn and Richter (1997, p. 40, 43) take a neo-institutional perspective by defining transaction costs as "the costs of resources utilized for the creation, maintenance, use, change, and so on of institutions and organizations. […] When considered in relation to existing property rights and contract rights, transaction costs consist of the costs of defining and measuring resources or claims, plus the costs of utilizing and enforcing the rights specified. Applied to the transfer of existing property rights and the establishment or transfer of contract rights between individuals (or legal entities), transaction costs include the costs of information, negotiation, and enforcement."

Transaction costs have entered into mainstream economics being widely applied with slightly different meanings to organizational structures (e.g. vertical integration), market failures (e.g. externalities and asymmetric information), institutional choices (e.g. promotion of clubs) and public choice (e.g. administrative costs). Overall, transaction cost economics has contributed to our understanding of observed patterns of organization (Rao, 2003). Transaction cost is now a generic term referring to any costs that come from realizing a transaction across a market. Accordingly, transaction costs can be interpreted as "the costs of *any* activity undertaken to use the price system" (Demsetz, 1997, p. 426) including – as we might add - market-based approaches of environmental policy.

3.3.2. Classification

Since different types of costs may be borne by different players at different points in the policy process, a proper classification of transaction cost categories is important to assure that all relevant costs are accounted for. When complete, a transaction cost taxonomy may also be helpful in improving policy design and management.

According to Dahlman (1979), transaction costs include:

- search and information costs,
- bargaining and decision-making costs,
- monitoring and enforcement costs.

The economic rationale of institutions lies in the reduction of those costs. This must be interpreted carefully. However, although institutions are, in principle, designed to reduce transaction costs by diminishing uncertainty, they may not succeed so. New or changing institutions may generate, at any point in time, inconsistencies between competing institutions as well as uncertainty over future institutional changes which, in turn, are likely to lead to increasing transaction costs (Meyer, 2001, p. 358).

Milgrom and Roberts (1992) distinguish between two categories of transaction costs. The first type arises from information asymmetries and incompleteness of contracts among parties. The second type stems from imperfect commitments or opportunistic behavior of parties. In his treatise on tradable emission permits, Stavins (1995) discusses the taxonomy of Foster and Hahn (1993) who distinguish between direct financial costs (of engaging in trade), costs of regulatory delay and indirect costs (associated with the uncertainty of completing a trade). In their classification, Dudek and Wiener (1996) include not only search, negotiation, approval, monitoring and enforcement costs, but also insurance costs.

The OECD (2001) has classified transaction costs into two categories:

- non-policy related transaction costs, which are incurred by parties to voluntary (market) transactions, and
- policy related transaction costs, which are associated with the implementation of policies.

The former include the costs associated with gathering information, negotiating prices, ascertaining qualities, establishing exclusion mechanisms, organizing collective actions and so on. The latter cover the costs incurred by government in gathering information, planning and designing policies, collecting revenues, distributing payments, and monitoring the outcome of policies.

According to Furubotn and Richter (1997), transaction costs involve the use of real resources that could be deployed alternatively elsewhere in the economy or the socioeconomic system. Transaction costs are pervasive at all levels and types of activity and inactivity and comprise the costs of establishing, maintaining, adapting, regulating, monitoring and enforcing rules as well as executing transactions. Interestingly, the opportunity costs of misallocated activities also fit into the category of transaction costs. They make a distinction between three types of transaction costs (p. 42):

- the costs of using the market (market transaction costs),
- the costs of exercising the right to give orders within the organization (managerial transaction costs), and
- the costs of running and adjusting a political system (political transaction costs).

For each of these three types, Furubotn and Richter recognize two variants:

- fixed transaction costs (set-up costs for institutional arrangements), and
- variable transaction costs (dependent on the number of volume of transactions).

Their taxonomy is the most complete to be found in the literature and comprises the costs of using the markets as introduced by Coase (1937), the managerial costs put forward by Williamson (1985) and the institutional costs discussed by North (1990). The Furubotn-Richter approach also absorbs the distinction made by Mullins and Baron (1997) between direct transaction costs (e.g. to initiate and complete a trade) and opportunity costs (e.g. the loss of time and resources due to delay or managerial supervision). Furthermore, transactions entail costs *ex ante* (e.g. the search and information costs and the costs of negotiating and forming a contract or agreement) and *ex post* (e.g. the costs of monitoring and enforcing a contract or agreement). In practice, however, ex ante costs often coincide with fixed costs and ex post costs with variable costs. It is important to recognize that the two types of costs are usually interdependent. Any attempt to reduce the former may affect the latter.

In table 1, we offer an extended classification based on the Furubotn-Richter taxonomy that is thought to include all relevant types of transaction costs. This scheme will be used for policy evaluation of tradable emission rights versus environmental taxes in the next chapter, tradable entry rights versus road pricing in the fifth chapter and tradable deficit rights versus regulation in the sixth chapter.

Table 1:Transaction Cost Taxonomy

Transaction costs	Fixed (ex ante)	Variable (ex post)
- Market	- Information costs - Search costs - Signaling costs - Negotiation costs - Contract costs	- Insurance costs
- Managerial	- Set-up costs	- Monitoring costs - Enforcement costs - Bonding costs
- Political	- Lobbying costs - Public support costs - Enacting costs	- Operational costs - Compliance costs - Delay costs

Source: Based on Furutbotn and Richter (1997)

4. Tradable emission rights versus environmental taxes[86]

4.1. Introduction

There is an increasing interest in having the government create markets in property rights to allocate various resources, such as environmental quality. The purpose of this chapter is to apply the theory of tradable permits to environmental problems. In order to do so, we will first discuss the different design issues related to emission rights. More specifically, location of the source and choice of the nature of the baseline matters when choosing a particular permit system. Then, we will elaborate on the most well-know cap-and-trade programs, namely the U.S. Acid Rain Program and RECLAIM. These case studies will help to understand the practical implications of introducing a system of tradable permits and lead to an inventory of general problems and possibilities of using tradable emission permits. Primarily, the key to a smooth functioning of the tradable permit market is a low level of transaction costs. However, it is a widely held view that corrective taxation entails substantial, though far fewer transaction costs than tradable permit systems. Therefore, we will explore all relevant market, managerial and political transaction costs associated with environmental taxes and tradable emission rights and conduct a comparative analysis.

4.2. Design issues of tradable emission rights

4.2.1. Emission versus ambient permit systems

Tradable emission permits are an instrument well-suited to restrict emissions in situations where location of the source, relative to receptors, does not matter, such as with uniformly dispersed pollutants. In other cases, where location does matter, air quality goals or deposition targets at certain locations can be approached by the creation of transferable ambient permits or deposition permits. An ambient permit is defined as the permission to deposit a given quantity of pollutants at a specific receptor (Ermoliev, Michalevich and Nentjes, 2000, p. 39). When creating such a system, the target deposition level for each receptor has to be specified. After subtracting background deposition, the remaining deposition at each receptor can be distributed as deposition permits among sources. In order to emit a given quantity of pollutants, a source has to have the appropriate number of deposition permits for each receptor it affects. If a source wants to increase emissions, it has to obtain additional deposition permits for each of the receptors in reach of its emissions (Ermoliev, Michalevich and

[86] Part of this chapter has been published as: Crals and Vereeck (2005) and Crals et al. (2005, forthcoming)

Nentjes, 2000, p. 39). An ambient permit system is appropriate for non-uniformly mixed pollutants such as SO_2, NOx, PM and VOC. However, the main reason that the system, although seemingly attractive from a theoretical perspective, has little practical application is because of the high transaction costs, especially with a large number of receptor points. Transaction costs inhibit trade by driving a 'wedge' between the price the buyer pays and that which the seller receives. As a result, transactions between sources are lower and a part of potential cost savings is not realized (Stavins, 1995, p. 139).

Ermoliev, Michalevich and Nentjes (2000, p. 40) point out that some of the markets for deposition permits might be thin. This can be the case if concentrations in the receptor point are affected only by local sources which are small in numbers. As a result, there will be imperfect competition in the permit market. They have shown in their paper that a market for ambient or deposition permits with multiple receptors can basically work but trade has to be sequential and multilateral. This means that a source which supplies deposition permits needs two or more trading partners who have a demand for deposition permits. This naturally makes trade more complicated. Furthermore, the global cap can be forgotten when focussing on a small scale.

Concluding, when the aim is to cap the emissions at lowest cost, an emission permit systems seems more appropriate. However, hot spots are almost impossible to avoid with these systems.

4.2.2. Emissions versus input trading

In principle, there is a need to regulate risks and impacts. However, it is quite difficult to trade risks directly. Therefore, policy typically moves one or two steps away from this level, leading to either emission permit trading or input permit trading. For example, a CO_2 trading program evidently corresponds to the first type while a carbon trading program belongs to the second group. The choice between the two groups depends on the degree of uniform mixing of the pollutant. For example, it would be problematic to use a sulfur content trading program because SO_2 is a highly non-uniformly mixed pollutant.

Aside from this physical property, there is also an economic or political aspect, namely administrative feasibility. The general rule is, the closer to the actual impacts regulation takes place, the more complex it gets (Schneider and Wagner, 2003, p. 4).

4.2.3. Absolute versus relative baselines

The difference between relative and absolute targets can be argued as follows (Schneider and Wagner, 2003, p. 5): "One limits total emissions to

some absolute amount and may therefore limit growth, while the other is presumed to impose less of a constraint on growth in output, albeit at the cost of some growth in emissions". Gielen, Koutstaal and Vollebergh (2002) have analyzed the most important differences between absolute and relative targets in case of emission trading. They show that relative cap-and-trade policies[87] amounts to the implementation of an absolute cap-and-trade mechanism together with a subsidy on output or input.

In practice, relative targets are often considered when establishing trading schemes. Gielen, Koutstaal and Vollebergh (2002) mention several reasons for this popularity. First of all, trading with relative targets is more easily combined with existing regulation and policies. Secondly, political acceptability exists because polluters only have to pay for emissions above the relative target and not for their remaining emissions. Also, relative mechanisms allow entry and expansion at no extra costs as long as emissions per unit of output or input are below the relative target. Nevertheless, in spite of this popularity, several reasons argue for using absolute baselines in tradable permit programs. The main reason is that trading with a relative cap is less efficient than trading with an absolute cap because a relative cap is a combination of a price on emissions and a production subsidy. Consequently, output will exceed the optimal output level and permit price and abatement costs need to be higher in order to meet the same emission target as in an efficient system with an absolute cap. Furthermore, the uncertainty is larger with relative caps. In addition, no revenue will be raised which could be used to lower the dead-weight loss of distortionary taxation. Finally, monitoring costs of relative caps will be higher. Schneider and Wagner (2003, p. 6) mention two other reasons which argue for using absolute baselines. First, without a specified baseline, reductions must be credited to an unobservable hypothetical, i.e. what the source would have emitted in the absence of the regulation. Second, relative baselines create significant transaction costs by essentially requiring prior approval of trades as the authority investigates the claimed counterfactual from which reductions are calculated and credits generated.

4.3. Emission rights in practice

When economists and policy makers are discussing tradable permits systems, they typically focus on the existing cap-and-trade systems in the United States because the international experience outside the U.S. is rather small[88]. We will first give an overview of some of other existing (credit as

[87] Relative cap-and-trade policies can also be defined as policies that restrict emissions per unit of output or input.

[88] Europe has only relatively recently begun to develop such programs. For example, in July 2003 the EU parliament approved the directive to establish a greenhouse gas emission

well as cap-and-trade) programs and then will further elaborate on two programs, namely RECLAIM which is implemented in the area Los Angeles of the United States and the U.S. Acid Rain Program where tradable permits are used for the first time on a large scale to contend with environmental pollution.

4.3.1. Credit programs

There a several examples of credit programs which have been or are currently running in practice. The most important ones are mentioned in the following table.

allowance-trading program for energy intensive sectors within the EU Member States (Schneider and Wagner, 2003, p. 2).

Table 2: Existing credit programs

Country	Program	Traded Commodity	Period of Operation	Environmental and Economic Effects
United States	EPA[89]'s Emissions Trading Program[90]	Criteria air pollutants under the Clean Air Act	1974 -Present	Performance unaffected; savings of $5-12 billion.
United States	Lead Trading	Rights for lead in gasoline among refineries	1982-1987	More rapid phase-out of leaded gasoline; $250 million annual savings
United States	Water Quality Trading	Point[91]-non point[92] sources of nitrogen and phospohorous	1984-1986	No trading occurred, because ambient standards not binding
Canada	PERT [93] and GERT[94]	NOx, VOCs, CO,CO_2, SO_2 CO_2	1996-Present 1997-Present	Pilot program Pilot program

Source: Based on Stavins (2000)

[89] Environmental Protection Agency.
[90] Firms that reduced emissions below the level required by law received 'credits' usable against higher emissions elsewhere.
[91] Point sources are sources of emissions rights which are well defined, like the emissions of a firm.
[92] Non point sources are sources of emissions where the emission points are not well defined, like the transport sector.
[93] Pilot Emission Reduction Trading (PERT)
[94] Greenhouse Gas Emissions Reduction Trading (GERT)

4.3.2. Cap-and-trade programs

The most important existing cap-and-trade programs are discussed in the following table.

Table 3: Existing cap-and-trade programs

Country	Program	Traded Commodity	Period of operation	**Environmental and economic effects**
United States	CFC[95] trading for ozone protection	Production rights for some CFCs, based on depletion potential	1987-Present	Environmental targets achieved ahead of schedule; effect of TP system unclear
United States	Acid Rain Reduction	SO_2 emission reduction credits; mainly among electric utilities	1995-Present	Environmental target achieved ahead of schedule; annual savings of $1 billion
United States (California)	RECLAIM[96] program	Local SO_2 and NOx emissions trading among stationary sources	1994-Present	Unknown as of 1997
Chile	Chilean Bus Licenses	Bus licenses sold via auctioning system to address congestion related pollution in Santiago	1991-Present	Congestion has been reduced, with emissions reduced proportionately
Chile	Chilean TSP tradable permits	Total suspended particulates (TSP) from stationary sources in the Santiago area	1995-Present	Emissions have decreased[97]; volume of emissions trading low; high transaction costs

Source: Based on Stavins (2000)

[95] Chlorofluorocarbons
[96] Regional Clean Air Incentives Market
[97] Also due to the introduction of natural gas as an alternative fuel.

4.3.2.1. The US Acid Rain Program (Title VI)[98]

Contrary to the attractive efficiency feature of market-based approaches for internalizing environmental externalities, this approach was seldom used. The environmental policy in the United States was mainly based on source specific command-and-control regulation by either posing a limit on the emissions or requiring specific technologies (Joskow and Schmalensee, 1998). The first use on a large scale of tradable emission permits was initiated by the Clean Act Amendments in 1990. At that time, the Bush Administration proposed a tradable permits approach in Title IV what became the Clear Air Act Amendments (CAAA) of 1990. Title IV was targeted at electric utility emissions (coil- and oil-fired electricity generating plants) of sulphur dioxide, the major precursor of acid rain (Joskow, Schmalensee and Bailey, 1998). In practice, Title IV places an aggregate cap on power plant emissions of SO_2 of around 9 millions tons, effective from year 2000 onwards. This emissions cap is equivalent to a reduction in annual emissions of some 10 millions tons as compared with 1980 (Smith, 2002, p. 47).

The Acid Rain Program was implemented in 2 phases. Phase I, covering the period 1995-1999, required aggregate emissions reductions of around 3,5 million tons per year from the 263 generating units with the greatest emissions at 110 mostly coal-burning electric utility plants located in 21 Eastern and Midwestern states[99]. An additional 182 units joined Phase I of the program as substitution or compensating units, bringing the total of Phase I affected units to 445. Emissions data indicate that 1995 SO_2 emissions at these units nationwide were reduced by almost 40% below their required level. Phase II, starting in 2000, extended the scope of the aggregate cap on SO_2 emissions to all coal-fired and oil-fired electric power plants above 25MW capacity. The act also called for a 2 million ton reduction in NOx emissions by the year 2000. A significant portion of this reduction has been achieved by coal-fired utility boilers that were required to install low NOx burner technologies to meet new emissions standards.

The basic principle of the Clean Air Market program is called allowance trading or cap-and-trade and has several characteristics. The cap-and-trade approach first sets an overall cap, or maximum amount of emissions per compliance period, that will achieve the desired environmental effects. Authorizations to emit in the form of emission allowances are then allocated to affected sources, and the total number of allowances cannot exceed the cap. In the Acid Rain Program, sulphur dioxide emissions were 17,5 million tons in 1980 from electric utilities in the United States. Beginning in 1995,

[98] Primarily based on the official site from the Environmental Protection Agency (EPA) www.epa.gov/airmarkets/

[99] The so-called Table A units.

annual caps were set to decline to a level of 8,95 million allowances by the year 2010. One allowance permits a source to emit one ton of SO_2. The basis structure of the tradable permit regime is built around an annual distribution of tradable emissions allowances mainly on a grandfathered basis. The permits may be used in the year of issue, or banked and used in a subsequent year[100]. As indicated by Burtraw (2000), the opportunity to bank allowances is expected to play a significant role in reducing compliance cost because it affords firms the flexibility to plan their investment activities. The permits can be traded freely across the entire US territory, on a 1:1 basis, either directly between emitting firms or through brokers[101]. The EPA plays no role in trade, however, a small EPA auction of about 2,8% of the total issue of allowances begun in 1993. This was intended to stimulate the development of the market for permits. The revenues were to be recycled to regulated sources. This auction offered a solution for the concern that an active market for permits would not arise because emitting firms would keep their initial allocation and refuse to sell at each price (Ellerman et al., 2000). At the end of the year, units must hold in their compliance sub accounts a quantity of allowances equal to or greater than the amount of SO_2 emitted during that year.

An essential feature of smoothly operating markets is a method for measuring the commodity being traded. The owner or operator of a unit regulated under the Acid Rain Program must install CEM systems[102] on the unit unless otherwise specified in the regulation. All CEM systems must be in continuous operation and must be able to sample, analyze, and record data at least every 15 minutes. Utilities can choose themselves how to reduce emissions i.e. by employing energy conservation measures, increasing reliance on renewable energy, reducing usage, employing pollution control technologies, switching to lower sulphur fuel, buying additional permits or other alternative strategies. Consequently, the utility can choose for the most cost-effective way to achieve the Clean Air Act rules. This flexibility was not possible under the traditional command-and-control approach.

---

[100] Borrowing is not allowed.

[101] Permits may be bought, sold and traded by any individual, corporation, or governing body, including brokers, municipalities, environmental groups, and private citizens. The primary participants in allowance trading are officials designated and authorized to represent the owners and operators of electric utility plants that emit SO_2.

[102] Continuous Emissions Monitoring or CEM is the continuous measurement of pollutants emitted into the atmosphere in exhaust gases from combustion or industrial processes. CEM systems include: an SO_2 pollutant concentration monitor, a NOx pollutant concentration monitor, a volumetric flow monitor, an opacity monitor, a diluent gas monitor and a computer-based data acquisition and handling system (DAHS) for the recording and performing calculations with the data.

Under the Acid Rain Program, anyone can purchase allowances, including both regulated companies and members of the general public. In addition to buying allowances directly from a company or individual who holds them, allowances can be bought in three ways:

1. Through EPA's annual auction. Once a year, EPA auctions a certain number of allowances at the end of March. Utilities, environmental groups, allowance brokers, and anyone else interested in purchasing allowances can participate. Allowances will be sold at the highest bidder until no allowances remain;
2. Through a broker. Brokers bring together parties that have allowances to buy and sell. They are more appropriate for higher-volume allowance transactions;
3. Through environmental groups that retire allowances so they can not be used to cover emissions. Some individuals and groups buy permits as a environmental statement because this will lower SO2 emissions of facilities.

At the end of the compliance period, every source needs sufficient permits to cover its emissions. To accomplish this, EPA maintains an Allowance Tracking System (ATS). Each affected utility unit, corporation, group or individual holding allowances has an account in the ATS. Parties must notify EPA that records transfers in their ATS account. However, EPA records only when allowances are to be used to meet a unit's SO_2 emissions limitation requirement. An ATS account contains the following information:

- Issuance of all allowances;
- How many allowances an account holds;
- How many allowances are held in various allowance reserves, such as the EPA auction reserve and the Conservation and Renewable Energy Reserve;
- Deduction of allowances for compliance purposes;
- Transfer of allowances between accounts.

After the final submitted transfers are recorded on the ATS, EPA deducts allowances from each unit's compliance sub account in an amount equal to its SO_2 emissions for that year. If the unit's emissions do not exceed its allowances, the remaining allowances are carried forward, or banked, into the next year's sub account which then becomes the current compliance sub account. If a unit's emissions exceed its allowances, the unit must pay a penalty and surrender allowances for the following year to EPA as excess emission offsets. Every unit has 30 days after the end of the year to present sufficient rights for the emission of the previous year.

Ellerman's et al. (2000, p. 314) analysis has indicated that the Acid Rain Program has thus far been a notable success. Title IV more than achieved

the SO_2 emissions-reduction goal established for Phase I, and it did so on time, without extensive litigation, an at costs lower than predicted. Moreover, there has been 100% compliance by all affected sources. Therefore, the U.S. Acid Rain Program can offer valuable lessons for the design of a system of tradable permits in the future. As Ellerman et al. (2000, p. 315-316) state, the experience thus far with Title IV clearly establishes that large-scale tradable permit programs can work more or less as theory describes (see chapter 3). By providing flexibility to polluters along with rigorous emissions measurement and enforcement, such programs can both achieve stated environmental objectives and reduce compliance. However, it is also important not to forget that theory also tells us that the emissions trading approach is not well suited to some environmental programs[103].

Ellerman et al. (2000, p. 317-318) also indicate that efficient, competitive markets for tradable permits can develop when program design and implementation are favourable. His analysis (Ellerman et al., 2000, p. 197) shows that around the middle of 1994, a reasonably efficient market for allowances has emerged. That is, prices for allowances were easily available to buyers and sellers, transaction costs were low, arbitrage opportunities were quickly exploited, and buyers and sellers were taking advantage of the opportunities to reduce compliance costs by engaging in trading activity. The most important factors contributing to this efficient market were the fundamental design of an allowance and the subsequent implementation of the Acid Rain Program by the EPA. The key design elements were:

- Rights to emit SO_2 were being traded rather than reductions of SO_2 emissions[104]; and,
- Each allowance was worth the same amount (one ton of SO_2) regardless of when or between whom it was traded.

Different estimations of the long term marginal and annual costs of the SO_2 program and cost savings from allowance trading are summarized in table 4.

[103] For example, if a specific, isolated plant is emitting toxic chemicals that put nearby residents at excessive risk, emissions trading has no obvious role. It may be better to use emission fees or taxes to deal with problems of that sort, but direct regulation is likely to have more appeal.

[104] This distinction is important for the development of a market. Emissions are what damage the environment, and measuring them is, at least in this case, a relatively routine engineering problem. Specifying and fixing emissions reductions cannot be done so easily, though, unless it is known in advance what emissions would have been absent the control program begin implemented. Therefore, transaction costs will be much higher with emission reductions.

Table 4: Estimates of Long-run (2010) Annual and Marginal Cost of SO2 program

Study	Annual Cost (billion 1995 dollars)	Marginal cost per ton SO2 (1995 dollars)	Average Cost per ton SO2 (1995 dollars)
Carlson et al. (1998)	1.0	291	174
Burtraw et al. (1997)	0.9		239
White (1997)		436	
ICF (1995)	2.3	532	252
White et al. (1995)	1.4-2.9	543	286-334
Van Horn Consulting et al. (1993)	2.4-3.3	520	314-405
ICF (1990)	1.9-5.5	579-760	280-467

Source: Based on Burtraw (1999)

For the evaluation of the program compared to prior expectations, the most useful study is ICF (1990), which was done for the EPA and available prior to enactment of the legislation. This study captured accurately the ultimate design of the regulation, and projected marginal cost of $579-760 (1995 dollars) for full compliance under the program. In 2000, Butraw studied the costs of compliance and concluded by stating that these were significant less than anticipated at and before the program adoption. Important has been the role of changing fuel prices and in the long run the role of technological change. These factors combine to lower expected long-run costs by over half of what was anticipated at the outset of the program.

While total costs, as we have seen, have been on the low side of predictions, allowance prices have been much lower than the long-run marginal cost of abatement, which they would approximate in a well-functioning market at long-run equilibrium with reasonably good information and low transaction costs. Furthermore, allowances prices are also less than the average cost of abatement which, in a world of efficient compliance decisions and varying abatement cost among units, would be lower than long-run marginal cost. As discussed by Ellerman et al. (1997, p. 42), the average total cost and the long-run marginal cost of abatement in 1995 were approximately $200 and $300 a ton, respectively; yet, since Phase I began, allowance prices have ranged from only $70 to $130. Two explanations are made by Ellerman et al. (1997, p. 42). The first is that the disparity reflects serious imperfections in the allowance market, driven largely by early defects in the EPA auctions. However, Ellerman's analysis of the market evolution strongly suggests that it evolved quickly into a well-functioning market with low transaction costs, price transparency, and extensive trading activity. A second explanation for the gap between allowance prices and average abatement costs is that some utilities were forced by political pressures to

invest in high-cost abatement technologies, in particular scrubbers[105], thereby helping to protect local businesses and jobs.

In conclusion, efficient, competitive markets for tradable allowances may take time to develop, and the speed of development may be sensitive to some elements of program design. For example, as showed by Schmalensee et al. (1998, p. 66), the allowance auctions that the EPA was required to conduct seem to have facilitated both the price discovery process and the development of the allowance market. Price information is an important issue related to the design of an allowance market but market prices may well turn out to be higher or lower than predicted by studies.

4.3.2.2. RECLAIM[106]

The SCAQMD[107] Governing Board adopted the RECLAIM (Regional Clean Air Incentives Market) on October 15, 1993. The goal of RECLAIM is to provide facilities with added flexibility in meeting emission reduction requirements while lowering the cost of compliance in the area around Los Angeles. This region, the smoggiest in the nations, is required to achieve federal clean air health standards by 2010. The flexibility allows facilities the possibility to find new ways of reducing their emissions at lower costs and to trade emission permits on the market. In particular, the program has replaced source-by-source controls on emissions of nitrogen oxides (NOx) and sulphur oxides (SOx) with an emissions trading system for these pollutants, which limits the aggregate emissions within the area, and allows trading to determine the distribution of emissions across individual sources (Smith, 2002, p. 40). The RECLAIM program was anticipated by two years of research: six months to design the concept of the emissions trading program, one year feasibility study and one and a half year to develop the rules of the program.

Throughout the development of RECLAIM, the following five criteria were used to evaluate program options:

1. Enforcement of emission reductions must provide a confidence level equal to or greater than the existing air pollution control programs;
2. Emissions reductions (air quality) improvements must be equal to or greater than the 1991 AQMP[108] and future control plan requirements;

[105] Since scrubbers remove about 95% of the sulfur in flue gas, units installing scrubbers require fewer allowances to cover emissions than they were issued for in Phase I. Thus, scrubbing increases the supply of allowances available for sale or banking for future use, and therefore helps to drive down allowance prices.

[106] This section is mainly based on studies done by the agency running the program itself (SCAQMD, 1998). However, there are also some academic studies used, including Smith, 2002 and Stavins, 2000.

[107] South Coast Air Quality Management District.

[108] Air Quality Management Plan

3. Implementation costs must be lower than the cost projected in the 1991 AQMP;
4. Job impacts must be less than the cost projected in the 1991 AQMP; and,
5. Adverse public health impacts should not result from implementation of the program.

The development of RECLAIM began in 1990 and consisted of four phases. The first phase concluded with a public workshop that was held in October 1990 to obtain input for the development of the concept. Phase II began again with a public workshop to review Phase I and receive further input. A draft concept for a trading program was prepared in Phase II and based on this draft, Phase III started with a full-scale feasibility study. This study evaluated different alternatives for the program. After a lengthy Public Hearing, Phase IV began with the development of a series of rules and documents to implement RECLAIM for NOx and SOx. The actual implementation of the program started on January 1, 1994.

The basic concept of RECLAIM is that all major stationary sources with NOx and SOx emissions generally greater than 4 tons per year, will receive an annual emission cap and an annual rate of reduction. Sources such as equipment rental facilities, essential public services (including police, fire, landfills, waste water treatment facilities, hospitals, prisons, and schools), restaurants and dry cleaners are excluded from RECLAIM. At the beginning, the number of facilities included added up to 41 in the SOx market and 390 in the NOx market. Each facility received an annual emission allocation for sources emitting either NOx or SOx. Facilities can be in one or both markets. In practice, each facility received three sets of allocations as follows: a starting allocation for 1994; a mid-point allocation for 2000; and, an ending allocation for 2003. Consequently, the cap diminishes every year during 10 years (1994-2003). This reduction is equivalent to a 7 to 8 percent annual decrease in SOx and NOx emission in that period. The total SOx allocation began at 25 ton per day in 1994 and declined to 14 in 2000 and 10 (40 % of 1994 allocations) in 2003. The total NOx allocation began at 103 ton per day in 1994, declined to 35 in 2000 and 26 (only one quarter of 1994 allocations) in 2003.

Allocations are based on sources' past level of activity (grandfathering). The allocation is calculated on the peak activity level over 1989 to 1992 and on the emission control requirements for year 2000 and 2003 specified by the 1991 AQMP. Allocations were made to each RECLAIM facility at the start of the program, for each year from 1994 through to 2010. Allocations are valid in the specified one-year time period only, and there is no possibility for inter-temporal flexibility through banking or borrowing. As a result of this restriction on inter-temporal trade and the sharply-declining allocations,

the trading system operates against the background of an increasing scarcity of emission permits.

RECLAIM offers several advantages, both for the public and the business communities. The major benefit of RECLAIM is that air quality goals necessary to protect human health can be met in a more cost-effective manner. Secondly, RECLAIM will provide more flexibility for industry and will enable facilities to improve their long term planning and management of emission. Namely, it allows each facility to choose the most cost-effective strategy to meet annual emission targets. Facilities that hold emissions below their annual allocation can sell the difference to other facilities. RECLAIM also offers industry the ability to competitively develop and control their air pollution reduction strategy. Finally, RECLAIM will cap emissions, as opposed to the current practice of controlling emission rates. The public benefits from the program because it provides additional incentives for industry to reduce emissions and develop better pollution control technology.

The major costs of the program are the emission monitoring costs. CEMS is used in approximately two third of the participating facilities. The other facilities are using less accurate and more inexpensive technologies to measure their emissions.

The agency running the RECLAIM program, SCAQMD, is required under the rules of the program to make regular reports on various aspects of the program. Annual program audits are required on various specific topics, as well as a more comprehensive audit after three years of operation (Smith, 2002, p. 41). This three-yearly audit addresses a wide range of topics under ten headings:

- Changes in the number of sources subject to RECLAIM, including changes due to closure;
- The allocation of RTCs[109], in total, and between sources;
- Emission reductions achieved by RECLAIM sources;
- Trading activity and prices of traded RTCs;
- Compliance and monitoring costs;
- New Source Review Activity;
- Socio-economic analysis;
- Air Quality and Public Health effects;
- Amendments to the RECLAIM program; and,
- Changes to the program which are under consideration.

[109] RECLAIM Trading Credits.

The two key issues of general interest covered by the audit are the effects of the RECLAIM program on emission levels and on the level and pattern of trading activity (Smith, 2002, p. 42-43). The report shows that, for the first three years, emissions levels were below aggregate allocations. Approximately 24% of total NOx and 27% of total SOx allocations were unused in 1996. Although emissions were on a declining trend, the allowance allocation was declining more rapidly, and the audit anticipated that the crossover[110] years were about to be reached in 1999 for NOx and 2001 for SOx. Trading volumes were substantial; SCAQMD reported that by the end of 1997 1200 trades had taken place, covering about 0,25 million tons of NOx and SOx RTCs. A considerable proportion of RTC trading activity has been 'zero-price' trading, such as transactions between two plants under common ownership. Only 15% to 20% of trades have been 'priced' trades. The prices of TRCs have been well below the anticipated prices. However, these prices have highly increased in the further phases. Disadvantageous was the lack of automatic stabilization of prices because of the prohibition on inter-temporal trade. Finally, Stavins (2000) estimated - in ex ante evaluation of the cost savings of the RECLAIM program - yearly cost savings of approximately $58 million. This corresponds to a saving of 42% compared to the traditional command-and-control compliance costs.

4.4. General possibilities of using tradable (emission) permits

In essence, tradable permits can be environmentally effective, economically efficient, flexible, and designed so as to limit unwanted distributive aspects (Kitamori, 2002, p. 71). These advantages are already extensively discussed in the second chapter and will be just briefly repeated here. First of all, a system of tradable rights enables the government to determine a certain amount of pollution (cap) which is thought of to be acceptable in a certain area or time period. Then, the cap is divided into quota, the so-called emission rights. Consequently, the government forbids all pollution in that area unless the polluter has an emission right. Polluters can trade their permits and consequently, a market will develop. When a polluter wants to emit more, he has to buy additional permits from others who pollute less. In principle, cap-and-trade tradable permit schemes deliver certainty in their quantitative impact on emissions levels. In addition, the price is determined by the market and hence reflects the real marginal willingness to pay of the polluter. Secondly, tradable permits achieve static efficiency by minimizing the overall cost of compliance by encouraging those firms that can abate pollution more cheaply to do so first, while allowing those with higher abatement costs to opt for buying additional permits or allowances. Thirdly,

[110] Crossover years are years in which RTC demands exceed supply.

tradable permits allow firms greater flexibility in their choice of means for achieving the environmental objectives. Finally, depending on its design, a tradable permit scheme can better control the distributive effects of the policies, achieving desired income distribution or transfers among different groups through the choice of the initial permit allocation methods[111] (Kitamori, 2002, p. 72).

Besides these theoretical advantages, it is worth noting that some of the basic characteristics of greenhouse gases (GHGs) are particularly suited for emissions trading. As described by Kitamori (2002, p. 73), the location of emissions sources does not matter for GHGs and therefore allowing full geographical flexibility. GHGs become quickly uniformly mixed in the atmosphere and hence it makes no difference in terms of global climate change impacts if more emission abatement occurs at one source in place of another due to trading. Consequently, GHG emissions trading will not lead to hot spots problems. Similarly, full temporal flexibility in borrowing and banking of GHG emissions permits would make very little difference in terms of environmental impacts because the residence time of GHGs in the atmosphere is so long.

4.5. General problems of using tradable (emission) permits

4.5.1. Issues relating to the initial allocation and distributive aspects

In general, distributional effects[112] have two parts, the effects that arise through changes in prices and return to factors, and the wealth effects of changing ownership of a resource (Crals and Vereeck, 2004b, p. 11). The price effects, which are the most complex effects, are the same regardless the form of regulation. In particular, they are unaffected by whether permits are auctioned or grandfathered. Tietenberg (2001a, p. 206) puts it as follows:

> 'Whatever the initial allocation, the transferability of the permits allows them to ultimately flow to their highest valued use. Since that use does not depend on the initial allocation, all initial allocations result in the same outcome and that outcome is cost-effective. It implies that with tradable permits the resource manager can use the initial allocation to solve other goals such as political feasibility or ethical concerns without sacrificing cost effectiveness.'

In other words, regardless of whether a given volume of permits is auctioned or grandfathered, the permit price tends to be the same. We will

[111] However, this equity aspect arising from initial permit allocation is one of the most controversial and politically sensitive areas in the process of designing any tradable permit program.

[112] A classification of the types of environment-related distributional concerns that can arise are discussed by OECD (2004, p. 8-10). They also elaborate on what a fair distribution of environmental policy incidence is (p. 10-12).

show this using a numerical example. Assume that MAC of two firms (A and B) are assumed to increase, up to the level of 2200 (Q_0), at the point where, if no emission reduction occurred, 2200 would be emitted. Marginal abatement costs are assumed to be:

$$\text{MAC}(A) = 5 \,.\, \text{Q}$$
$$\text{MAC}(B) = 8 \,.\, \text{Q}$$

Where $Q = Q_0$ – allocation. First, we will calculate the market equilibrium price in case of grandfathering. We assume that each firm receives 1100 permits for free. This leads to the following:

Firm A: allocation = 1100 → MAC = 5500
Firm B: allocation = 1100 → MAC = 8800

Based on the firm's MAC curves, demand and supply curves can be derived:

$$\left.\begin{aligned} D(A) &= 1100 - 0.2p \\ D(B) &= 1100 - 0.125p \end{aligned}\right\} D = 2200 - 0.325p$$

$$\left.\begin{aligned} S(A) &= 0.2(p - 5500) \\ S(B) &= 0.125(p - 8800) \end{aligned}\right\} S = 0.325p - 2200$$

where $f(p) = \dfrac{Q_0 - allocation}{MAC}$. When equating demand and supply, the market equilibrium price $\cong 6769$.

Secondly, under the same assumption, we will calculate the market-equilibrium price when all rights are auctioned. Marginal abatement costs then are:

Firm A: allocation = 0 → MAC = 11000
Firm B: allocation = 0 → MAC = 17600

The demand curves of firm A and B are as follows:

$$\left.\begin{aligned} D(A) &= 2200 - 0.2p \\ D(B) &= 2200 - 0.125p \end{aligned}\right\} D = 4400 - 0.325p$$

Supply is fixed at 2200 permits. After equating demand and supply in this example, we find that the market equilibrium price of a permit again $\cong 6769$[113].

This example demonstrates that prices for both firms will be the same in case of grandfathering or auctioning[114]. At least, this is the case in the absence of any significantly different effects on the final wealth (or income) resulting from the two approaches, auctioning and grandfathering[115]. Wealth effects occur because ownership is being transferred from the commons to either the taxpayer, under taxes and tradable permits with auctions, or the recipients of grandfathered permits. More specifically, auction and tax revenue can be used in a multitude of ways[116] benefiting many different groups. In contrast, grandfathered permits redistribute wealth to shareholders. Only those who directly receive permits gain because a pure wealth effect[117] is produced. The aggregate distributional effects depend on the sum of the price and wealth effects (Cramton and Kerr, 1999, p. 259).

In theory, the distributional effects of tradable permits are similar to those of taxes since, as mentioned by OECD (2004, p. 17), in a partial equilibrium perspective, the use of a tax is comparable to a tradable permits system where the permits are auctioned[118]. However, the distributional effects will differ with the grandfathering of the permits where the rent is transferred from consumers to firms. As Parry discusses (2004, p. 366), grandfathered permits produce an income transfer towards higher-income groups at the expense of other households. This is because they create windfall gains for shareholders, who tend to be relatively wealthy; firms receive emission permits for free and the market value of the permits is reflected in higher firm equity values. There is no windfall gain to wealthy households under other market-based or command-and-control approaches. Under auctioned

[113] Suppose firm A receives 1000 permits for free and B 1200. Based on MAC and demand and supply functions, we find again that the price ¿ 6769.
[114] This analysis can be expanded to a larger number of polluters in the market.
[115] The term grandfathering, which reflects the idea that entities should be allocated permits in some relation to past emissions, is used here to cover any kind of principle of free allocations.
[116] As Cramton and Kerr (1999, p. 261-262) point out, labor, consumption, payroll or capital gains taxes could be cut or the deficit could be reduced. Only the political process and the normal constraints on redistribution limit the flexibility of compensation under auctions
[117] Grandfathering is usually used to compensate some current owners of specific capital.
[118] The distributional implications of environmentally friendly taxes can arise from the following categories (OECD, 2004, p. 17):

- the direct distribution effects on households arising from payment of the tax;
- the indirect distributional effects (for example when taxes are directed to firms but consumers pay a part of the cost through price increases);
- the effects arising from the expenditure of environmental tax revenues; and
- the effects relating to benefits of environmental improvements.

permits – as under emission taxes – the government obtains revenues that can be recycled in broad tax reductions, or reductions that favor the poor (Crals and Vereeck, 2004b, p 11)[119]. This was confirmed by Burtraw (2000) who said that, because scholars and policy analysts are attempting to draw lessons from the existing cap-and-trade programs, such as the U.S. Acid Rain and RECLAIM program, one area that should receive significant attention is the manner in which emission allowances are allocated to the industry. Evidence suggests that grandfathering of allowances can impose significant efficiency costs. Furthermore, this approach represents a tremendous transfer of wealth that raises equity issues as well. The possible significant inflows and outflows of money could thereby determine who would be the "winners and losers" of such a system. Burtraw (2000) recommends that emission allowances should be auctioned or allocated in some means that raises revenue for government that can be used to reduce other distortionary taxes. A hybrid program, in which some portion of allowances is grandfathered and the rest auctioned by the government[120], could offer a compromise that would improve programs of this type in future applications.

In general, taxes and auctioned permits are more likely to lead to equitable outcomes than grandfathered permits. Cost bearing is widely spread out and, in the long run, all costs are borne by consumers (Crals and Vereeck, 2004b, p. 12). Therefore, according to Cramton and Kerr (1999, p. 262), compensation should also be widely spread. To achieve this redistribution, auctioning permits or taxes are preferred.

4.5.2. Issues relating to different kinds of pollutants

Tradable permits are a suitable instrument for some pollutants but not for all. Particularly CO_2 poses a challenge compared to other local air pollutants such as SO_2 emissions. The latter are concentrated in a few industries while CO_2 is practically emitted by any sector, from numerous point and non-point sources. Also, reducing CO_2 emissions means reductions in energy flows and a shift towards more sustainable consumption patterns in general, whereas for other pollutants, abatement technologies are more readily available (Kitamori, 2002, p. 73).

[119] Examining the effect of a 15% reduction in U.S. carbon emissions under different allocation mechanisms, Dinan and Rogers (2002, p. 215) estimate that the lowest income households would be worse off under grandfathered permits while top income households would be better off. The low-income households would be better off if, instead, the permits were auctioned with revenues recycled in equal lump-sum rebates for all households.

[120] As used in the U.S. Acid Rain Program. However, in this program only a small amount is auctioned (see paragraph 4.3.2.1.).

4.5.3. Issues relating to social impact and political acceptability

The use of economic instruments to implement environmental policy has in the past been viewed with considerable skepticism and these doubts have yet to be fully allayed. There can be little doubt that political acceptability is still a weak point of tradable permits in most of the world's countries.

OECD (2001, p. 75-80) categorized the general reasons for these doubts. The first one deals with the conflict about the idea of a 'right to pollute' and that of the right to sell these rights to pollute. This provocative expression is sometimes unwisely used in the literature with reference to emission permits and is particularly misplaced as the aim of tradable permits is not to recognize a new right to harm where no such right existed before, but to severely restrict the exercise of this right in areas where it was unlimited or already recognized in the regulations (OECD, 2001, p. 77). The concept of rights has a positive connotation in the context of basis rights, whereas, if taken literally, the concept of a 'right to pollute' is perceived as a cynical and negative notion that establishes a right to harm others. Furthermore, it is often viewed that a public reward can not be given to those who pollute and such persons can not be allowed to earn money by selling a 'right to pollute'. Trading in pollutant emission permits would therefore be immoral by nature. The second weak point concerning the legitimacy of tradable permits deals with the fears of the local population with regard to both the environment and the potential impact on local employment. With tradable permits, no local community will be immune from new exposure to pollution and will not have at its disposal the means of controlling this new exposure directly at source. The concern over employment must be taken into account when designing the program by not undermining the economic properties that make tradable permits attractive since it is by allowing the costs of an environmental program to be kept as low as possible that any adverse impacts on the local economy and employment can be reduced (OECD, 2001, p. 79). Finally, there exists a fear of loss of market power on the part of different actors when introducing tradable permits. The administrative officials in public services are frequently members of groups hostile to the development of tradable permits, since introduction of the latter would remove their oversight from the choices of technology made by firms. Similarly, the introduction of tradable permits can lead to changes in the organization of internal responsibilities within firms by assigning responsibility for environmental matters to financial, and no longer solely engineering, departments. This shows that the successful introduction of tradable permits requires often a change in the culture of an organization (OECD, 2001, p. 79).

Crals et al. (2005, forthcoming) mention the following reasons for the lack of political and social acceptability:

– Within the broad public, the following misconception dominates: a public good is now taxed and this price is more seen as a burden than as a means to initiate people to more sustainable behavior. Consequently, price mechanisms are often seen as more unjust than administrative regulation. This is also called price-aversion which exists for government intervention in general: people oppose all new taxes. Finally, people are very sensitive to redistribution aspects in the sense that the losers in this system are more identified than the winners.

– Politicians are not very enthusiastic about price mechanisms because the voting public does not attribute a well functioning price mechanism to their activities. In other words, little re-election gains can be made. Moreover, direct regulation offers more possibilities to wield power than price mechanisms.

– Within administration, little acceptability can be found because price policy does not belong to the policy traditions. Officials also more believe in the effectiveness of regulation.

– Finally, interest groups are opposed to price control measures because these offer less negotiation space to influence political decisions. The efficiency gains of price control measures are a public good which unsatisfactory can be attributed to the political decision-making process.

As price control measures become incorporated in a whole set of measures on the supply and demand side, legitimacy will increase. The level of acceptation is also dependent on the tax level and the use of the revenues that are created. It can be assumed that acceptability will increase as revenues flow back to the people who have paid.

4.5.4. Issues relating to transaction costs

Transaction costs may inhibit trade, and may therefore reduce the extent to which potential savings are realized in practice (Smith, 2002, p. 33). Rao (2003, p. 158) has suggested that the systems of market-based emissions trading, even the well-developed programs in the United States, still have a long way to go before being effective in any sense because of excessive transaction costs. However, there exists no empirical evidence that transaction costs have prevented trading or significantly affected prices of permits in the United States (Michaelowa et al., 2003). Moreover, the occurrence of high transaction costs in emissions trading does not imply that environmental taxation is any less susceptible. Because of the importance of this issue, we will examine this matter further by comparing the transaction costs of tradable emission permits and environmental taxes in the following paragraph.

4.6. Transaction costs

Market-based environmental policy instruments are the practical outcome of the Pigouvian and Coasean legacies. From an ecological and economic perspective, it is clear that tradable emission rights outperform environmental taxes, but the crux of the former system seems the transaction costs it entails. While the literature on environmental economics has been discussing transaction costs of tradable permit systems (*e.g.* Stavins (1995), Woerdman (2001)), a comparative analysis of the transaction costs incurred by environmental policy instruments across all stages of the policy process is still lacking (Krutilla, 1999). It is our purpose to make a first attempt. In the previous chapter we have already proposed, by surveying the literature, a taxonomy of transaction costs. Using this taxonomy, a comparative assessment is made of the transaction costs generated by ecological taxation on the one hand, and tradable emission permits on the other.

4.6.1. Determination of relevant transaction cost categories

From table 1 in the third chapter, we first select those types of transaction costs that are relevant for assessing public policy. By analyzing the same set of cost categories, we try to set off criticism that most studies are incomplete or that different definitions make any comparison virtually impossible (Woerdman, 2001, p. 300). To pursue a market-based environmental policy, the following, more or less chronological transaction costs are likely to be incurred:

- gathering information about environmental damages and the behavior of polluters,
- securing public support for ecological policy,
- lobbying politicians,
- enacting legislation,
- setting up the administration,
- operating the environmental program,
- searching for the relevant sources of pollution and designing the instrument accordingly,
- negotiating with the environmental authority or among polluters (including signaling and bonding),
- contracting with other polluters,
- monitoring the behavior of polluters,
- enforcing the legal requirements of the environmental program,
- insuring against the costs of environmental damage claims,
- private administration to comply with the program's requirements,

– delay in policy implementation or execution.

In our analysis, we will not discuss those cost types that are indifferent to both approaches and thus not relevant for comparative analysis. This is the case for insurance costs since they are determined by tort law and insurance market conditions. The same applies to parliamentary procedures and enacting costs which are incurred irrespective of the policy instrument chosen. While legislative delay may have serious environmental consequences, the transaction costs thus caused are just extra lobbying and public support costs. Although environmental taxes are sometimes imposed retroactively, we will not consider them as delay costs since they are not transaction costs inherent to the instrument. Hence, only lobbying and public support costs are considered as legislative costs. All relevant transaction cost categories are summarized in table 5. This scheme is the blueprint for the next paragraphs.

Table 5: Chronological Transaction Costs of (Environmental) Policy Process

Transaction costs	Fixed	Variable
- Political	Legislative costs - Lobbying costs - Public support costs	
- Market	Information costs Search (planning) costs	
- Managerial	Set-up costs	
- Political		Operational costs
- Market	Negotiation costs Contract costs	
- Managerial		Monitoring and enforcement costs
- Political		Compliance costs

4.6.2. Environmental taxes

Corrective taxation is itself not costless. All relevant transaction costs associated with environmental taxes will be discussed first.

4.6.2.1. Legislative costs

The decision on the instrument to be applied in environmental policy is formally the competence of the legislator who is supposed to act to further the public interest. But politicians are also influenced by various interest groups (Stigler (1971), Becker (1983)) like the polluting industry, environmental organizations and bureaucracy. Lobbying is thus likely to prevail because those affected by a policy may benefit or suffer from the choice of the policy instrument. Therefore, they have an incentive to influence the political process. As Olson (1965) pointed out, lobbying and

subsequent lobbying costs are more likely to arise when interest groups are small and have a high per capita stake.

Following Buchanan and Tullock (1975), we assume that the polluting industry prefers that policy instrument which maximizes profits. In the short run, the political decision to reduce emissions imposes scarcity and thus creates a rent. In a system of (non-) tradable quota, the industry may capture part of this rent. With ecological taxation, however, the government will confiscate the whole rent. Therefore, the polluting industry is most likely to campaign against taxes. Although environmental tax revenues can benefit the rest of society through increased spending or reduced taxing, the industry is expected to be a more effective lobbyist since it has fewer members with a higher per capita stake. Dewees (1983) has broadened the analysis by including (long-run) abatement costs and distinguishing between shareholders (who want to maximize share value) and workers (who seek to retain their jobs). This time, their interests are very alike though. Taxation reduces production, profits and jobs since output prices will increase reflecting environmental taxes as well as long run abatement costs.

Without explaining their preference ordering, it used to be ascertained that environmentalists eschew market-based approaches (Hahn, 1989). However, if we plausibly assume that ecological organizations are risk-averse and wish to maximize the reduction of pollution, they are likely to advocate an environmental policy that is certain and effective, or even over-effective. Since information, let alone perfect information on damages is often lacking, the impact of emission charges on total emissions is highly uncertain. This has led to a change of mind among environmentalists who nowadays campaign for the implementation of tradable permits schemes.

Assuming that (environmental) bureaucrats have a strong preference to maximize the budgets they administer (Niskanen, 1971), they are likely to lobby in favor of environmental taxes which not only increase their spending power, but also entail substantial information gathering and collecting costs for which additional budgetary sources have to be tapped.

The decision which environmental policy instrument should be chosen is made by politicians who also seek re-election (Peltzman (1976), Hahn (1990)). They thus have a clear incentive to favor their voters and decide in line with their preferences (Helfand, 1999). A traditional leftist politician will consider the interests of the working class with some concession to environmentalists. A traditional right-wing politician will weigh the interests of shareholders and workers and rank them above the environmentalists. Both the traditional left and right are thus expected to dislike environmental taxation. However, the executive branch of government relies on the bureaucracy for information and implementation.

This might explain why taxation, largely preferred by bureaucracy, has been more widely applied.

From the private interest approach, it follows that public support for environmental taxes is low. Nevertheless, an environmental authority that wishes to impose eco-taxes, has some options to successfully raise the level of public support. Assuming a low treasury preference, the costs of public persuasion can be mitigated by linking the implementation to an environmental tax reform, earmarking the revenues or taking advantage of an environmental catastrophe.

In conclusion, it seems reasonable to state that that the legislative costs of environmental taxation, in particular rent-seeking costs, are substantial.

4.6.2.2. Information costs

The literature on environmental tax policy leaves room for a possible *net* welfare gain of corrective taxation. The argument implicitly assumes, however, that the tax authority knows both the damage and benefit functions of victims and polluters (Baron, 1985) along with the price elasticity of demand, which is largely dependent on the availability of non-polluting alternatives and income elasticity. If not, the environmental tax authority can not set the optimal tax rate in terms of its emission goals. In practice, this type of information is hard to get by, so that governments become involved in a trial-and-error process of adjusting and readjusting the tax rate in an attempt to reach the emission target (Woerdman, 2002, p. 31). This scepticism is shared by the European Commission which points out that, while a levy set too low will not fully correct the externality, a tax set too high replaces one distortion by another (COM, 1997). Sandmo (1975), however, has convincingly demonstrated the positive welfare effects of corrective second-best taxation in a general equilibrium setting. But, once again, it requires additional information about existing distortions.

Information costs may further rise when differentiated taxes are to be implemented in accordance with pollution characteristics (for example, different fuel types) or the benefits derived by each victim from abatement in case of incentive taxation (see below). This would require differentiated assessments of individual utilities (Kolstadt, 1987). Finally, environmental pollution is often the result of accidents. Uncertainty also complicates the correct assessment of expected social costs.

From this, it can be concluded that the information costs related to effective and efficient environmental taxation are high.

4.6.2.3. Search (planning) costs

First-best analysis expects the tax authority to use personalized taxes and lump sum transfers since they do not bring additional distortions to the economy. Baumol and Oates (1988) have asserted that the link between the environmental externality and the tax base should be carefully established and that the corrective environmental taxes should be levied as close as possible to the source of pollution. If it were possible to locate the polluters and the victims, the question remains who should be taxed. In case of incentive taxation, the victims pay the taxes that finance the abatement. When this linkage principle is violated, there is a risk that the tax incidence is unduly shifted or that resources are reallocated to non-taxed uses. Locating the environmental damage is easy in theory, but not in practice since victims may spread in time and place. However, if taxes are not linked to the sources of pollution, free rider effects might occur.

Search costs can be somewhat mitigated, though, when the source can be linked to the cause of pollution. Taxing substances entails fewer information and search costs compared to personalized or incentive taxation. Search costs can be further reduced when the tax units are already identified. This is the case for user charges and indirect tax rate differentiation for healthy products or income tax deductibles for environmentally friendly behavior by consumers or businesses.

However, it should be pointed out that a trade-off exists between search and planning costs on the one hand, and the efficacy of the tax instrument on the other.

4.6.2.4. Set-up costs

With the rise of the modern welfare state, the scope of taxation has increased dramatically (Webber and Wildavsky, 1986). Consequently, governments have set up large agencies to administer and collect all types of direct and indirect taxes that touch upon almost every aspect of human life (consumption, production, business initiative, work, home and even death). If the new environmental taxes can be levied and collected by an established tax agency, set-up costs are negligible and sunk.

For example, charges levied on products that also fall under a VAT or sales tax regime can easily be administered by the direct tax administration. Analogously, the real estate tax agency is well equipped to levy user charges, for example on water provision, since it holds relevant information on the properties of buildings.

4.6.2.5. Operational costs

Negligible set-up costs do not imply that the costs of tax administration are low. Environmental taxation requires specialized personnel that gathers the

information discussed above, identifies the correct tax base, determines the optimal tax rate, feeds that information into the existing tax system and, if revenues are earmarked, collects the tax money and establishes a special fund. Although overhead costs can be spread among taxpayers, the costs of operating the tax administration are certainly not negligible and rising with the complexity of the tax law.

4.6.2.6. Negotiation costs

Although corporations and tax authorities often negotiate tax deals that may include environmental taxes and personalized tax deductibles for abatement investments, it is assumed that these negotiations are restricted to larger companies and that no tax bargaining occurs among tax subjects. As a matter of fact, taxation is compulsory precisely to eradicate these transaction costs. Hence, negotiation costs are relatively small.

4.6.2.7. Contract costs

No costs are incurred as a result of contracting over environmental taxes.

4.6.2.8. Monitoring and enforcement costs

Because polluters want to reduce the tax burden, they can choose to invest in abatement equipment (if the pay-off exceeds the tax payments), to reduce their polluting activities, to switch to non-taxed activities or to try and escape tax payments. Clearly, the environmental tax administration has to perform costly monitoring activities to ensure compliance and enforce tax payments (Bontems and Bourgeon, 2001). It is important to distinguish three different problems: tax evasion, tax avoidance and tax delinquency. While tax evasion is a fraudulent effort to escape a tax obligation, tax avoidance occurs when a taxpayer adapts his behavior in a lawful manner so as to minimize tax payments. Tax delinquency refers to a (temporary) failure to pay the tax obligation and will not be discussed here.

Tax enforcement relies on a mix of instruments: disclosure requirements, audits, on-site inspections and penalties[121]. What is important in our analysis, is that the costs of the monitoring and enforcement methods are determined in general by the transparency of the tax formula. The simpler is the tax rule, the harder it is to contest or manipulate. The complexity of the tax system is thus raising the monitoring and enforcement costs (Kaplow, 1996). Complexity typically arises from the need to make the tax base and rate accurately reflect the goals of public policy. More accurate tax rules may better serve equity or efficacy, but are also more costly to monitor and enforce. Kaplow has, therefore, suggested that the original policy goal may be sacrificed to some extent for the sake of lowering enforcement costs. The Baumol-Oates linkage principle provides proof for that: the closer a tax is

[121] The latter should be high enough to deter taxpayers from committing fraud.

levied to the source or victim of pollution, the more effective is the tax, yet the more costly is its implementation due to information problems. It can thus be concluded that monitoring and enforcement costs are proportionate to the information and search costs associated with more complex rules. In case of environmental taxation, they tend to be very high.

4.6.2.9. Compliance costs

Administrative mechanisms to prevent tax evasion also lead to costs made by the taxpayers to comply with the rules. The main source of compliance costs involves recordkeeping and banking operations. Compliance costs can be substantial and are estimated, for example, at 7 percent of total income tax revenue (Slemrod and Sorum, 1984). Like the previous cost category, compliance costs arise on account of more accurate, yet complex rules that link taxes more directly to the impact of pollution.

4.6.2.10. Conclusion

From this analysis, two main conclusions can be drawn. First, the transaction costs of environmental taxation are conditional upon the selected tax base. Although set-up costs are relatively low when drawing upon existing tax administrations, the enforcement and compliance costs are likely to be substantial. The latter costs are determined by the tax rules' complexity which, in turn, seems a consequence of the linkage principle. The more accurately the tax base is defined, the higher the information costs and subsequent monitoring, enforcement and compliance costs. The main reason is that personalized taxes give an incentive for taxpayers to hide information in order to lower their tax payments.

Secondly, there appears a trade-off between transaction costs and the efficacy of environmental taxes. Corrective taxation, though desirable in principle, may entail prohibitively high transaction costs that can only be reduced to some extent by sacrificing its original goal viz. matching private and social costs. In conclusion, transaction costs rely on the design of the tax system.

4.6.3. Tradable emission permits

The introduction of a tradable permit system serves two purposes, namely to effectively cap environmental harm and efficiently internalize the environmental costs by setting the right price for the permits. The latter aim can be impaired in part by the prevalence of prohibitively high transaction costs. Will transaction costs greatly reduce the benefits of an emissions trading system as some authors[122] have suggested?

[122] See e.g. Jackson (1995), Pearce (1995), Mullins and Baron (1997), Rao (2003, p. 158).

4.6.3.1. Legislative costs

It has been argued that a polluting industry has rent-maximizing incentives to prefer emission quotas over environmental taxes (Buchanan and Tullock, 1975). Trading quotas gives firms the flexibility to adjust their level of output or abatement to maximize profit. Before trade among polluters can start, the environmental agency has to distribute the permits. This can be done in essentially two ways: for free or by auctioning. In the former scenario, the industry happily captures the rent from imposed scarcity. If the permits are auctioned, however, profits are absorbed by the price that has to be paid. In case of an auction, the effects on profits and jobs are likely to be negative and similar to environmental taxation. Dewees (1983), however, has pointed out that the interests of shareholders and workers may be at conflict here. While the former can make a profit on excess permits by installing new abatement technology, jobs are expected to be lost when higher abatement costs and/or profits are reflected in output prices. The industry as a whole is, thus, assumed to prefer freely distributed emission rights.

In the private interest approach, environmental organizations are understood to optimize the efficacy and certainty of environmental policy. This may explain their (recent) zeal for the implementation of tradable emission permits programs. Since an auction of permits may yield additional funds for environmental improvement, they rationally prefer this distribution mechanism.

Bureaucrats' budget-maximizing behavior is constrained, among others, by performance audits of a supreme auditing office. When civil servants are in regular need to demonstrate that they have not been wasting taxpayers' money, they will carefully consider the efficacy of policies. Since environmental targets are more likely to be met under a cap-and-trade program, this clearly countervails their tax preference. If politicians would decide in favor of the implementation of tradable emission rights, bureaucrats have clear budget-maximizing incentives to favor an auction system.

Recently, Stavins (2002, p. 14-15) wrote that, although the political world was slow to embrace the use of market-based instruments for environmental protection, they have moved center stage, and policy debates look very different from the time when these ideas where characterized as "licenses to pollute" or dismissed as completely impractical. It is clear that market-based solutions have gained in acceptance. The idea that the efficacy of the existing policies is insufficient compared to emissions' trading brought about this favorable change of perception vis-à-vis tradable permits (Woerdman, 2002, p. 452). Politicians from the left to the right, all seeking re-election, are inclined to support tradable emission rights. While the leftist

electorate would prefer auctions to increase public spending, freely grandfathered tradable permits are more likely to appear on the political agenda under a right-wing coalition in order not to impair the profitability of companies. The removal of political barriers is also reducing the remaining public support costs of tradable emission rights. Public support can be further enhanced through workshops in local communities or with industrial and environmental groups and by new feasibility studies revealing more participatory implementation scenarios.

Since political and public support is on the rise, it seems reasonable to conclude that rent-seeking costs remain relatively low.

4.6.3.2. Information costs

Tradable emission permits have one major cost advantage. The environmental authority only has to set the total amount of pollution (rights) deemed acceptable and does not need to gather additional information about damages, abatement costs or price elasticities. The initial distribution of the permits, however, may entail some information costs. Basically, there exist three schemes to distribute the emission rights among polluters:

- free (no information is needed about past of future pollution of market participants),
- auction,
- grandfathering or updating, i.e. based on historical, respectively last year's emissions which requires the regulatory agency to keep individual emission records.

The design of the program may thus be a source of data collecting costs. Saving transaction costs through the free distribution of permits does not harm the efficacy of the instrument since trading ensures that the permit ends up in its highest valued use. Hence, compared to environmental taxation, information costs are negligible.

4.6.3.3. Search (planning) costs

Apart from the initial distribution of rights, the design of a cap-and-trade program entails several other planning issues such as the geographic area, the span of temporal flexibility and the nature of the permit (Harrison, 1999).

A larger geographic area is more likely to guarantee a sufficient number of trading partners. To ensure market liquidity, a tradable permit system thus has to be set up on a sufficiently large scale. Moreover, pollution is a typical cross-border problem that needs a solution on an international, global level. The permits that are distributed at the beginning of each year should remain valid for one year only since borrowing, i.e. the use of next year's permits,

not only causes great monitoring and enforcement problems, but also encourages speculative behavior. As far as the nature of the permit is concerned, the cap sets a physical limit on total pollution, for instance million tons of CO_2. When the production of CO_2 is the outcome of fossil fuel consumption, CO_2 permits may take the form of tradable fuel permits.

Once again, search costs are dependent on the design of the program (for example, allowing borrowing). Since low cost alternatives do not impair the efficacy, it is fair to conclude that search costs can be kept low.

4.6.3.4. Set-up costs

To regulate the market, an environmental agency is to be set up holding three important responsibilities: determination of the annual cap, distribution of permits and enforcement of the system. These new tasks seem to require the establishment and funding of a new public agency or division. The extent of the set-up costs is largely dependent on the distribution system chosen. For example, in contrast to the free distribution of rights will grandfathering, updating or auctioning of permits necessitate substantial investments in information technology and/or auction design. These costs are not system-specific. For example, a system of tradable cordon rights is likely to use the same information technology (viz. license plate scanning) as the entrance toll system recently implemented in London. The market for tradable fuel permits can be set up with technology that already exists and works today. The permits can be put on smart cards that are fraud-resistant and allow easy and inexpensive transactions (at cash dispensers and gasoline stations). Recharging the card can be done via the internet using an individual internet account number (Crals, Keppens and Vereeck, 2004).

In conclusion, set-up costs can be substantial and are determined by the information needs of the distribution mechanism and the availability of trading technology. Free distribution and existing technology are likely to induce the least set-up costs.

4.6.3.5. Operational costs

The operational costs also largely depend on the initial distribution method and the trading regime. More data and personnel are needed to feed the information requirements of a grandfathering or updating program than a free distribution scheme. When the permits are auctioned, maintenance costs have to be taken into account as well. Sometimes, the approval from the environmental agency is needed to complete a trade. For that reason are simple approval processes, few requirements and well defined emission rights essential to keep operational costs down (Hahn and Hester, 1989, p. 378). According to Mullins and Baron (1997, p. 31), the rules for governing

the trading system can have a dramatic effect on transaction costs. For instance, it will make finding an acceptable buyer or seller more difficult.

So, in order to keep operational costs down, permit holders should be able to sell their excess permits with as little regulatory interference as possible.

4.6.3.6. Negotiation costs

When entering into negotiations, parties first have to search for other partners to trade. When market participants are confronted with substantial search costs, fewer transactions will be concluded. The environmental authority can, therefore, set up different market types to facilitate the trade of permits:

- direct search markets (without intermediaries),
- brokered markets (with intermediaries but with market players still holding the rights),
- dealer markets (where intermediaries hold the rights),
- auction markets (where the environmental agency holds the rights).

Financial institutions or insurance companies can reduce search costs by acting as brokers between buyers and sellers. Tietenberg (1999) has argued that these costs can also be reduced by establishing a clearing-house.

Once a party has found another party to trade, bargaining will start. This bargaining process will be standardized and entail fewer transaction costs when information on permit prices is publicly available. Clearing-houses, spot and futures markets and auctions are most likely to ensure that prices are publicly available.

Negotiation costs thus depend upon the design of the trading regime and the observability of permit prices.

4.6.3.7. Contract costs

The costs of contracting are zero since the purchase of a permit is a spot transaction. Since there is no time lapse between the promise and actual transfer of the emission right, there is no room for opportunistic behavior that necessitates contractual protection of the buyer.

4.6.3.8. Monitoring and enforcement costs

Basically, there are two ways to monitor a tradable permit program: upstream where producers are monitored, and downstream where policing is focused on the end-users. Significant differences between the two approaches exist with regard to the type and number of market players that need to be monitored. Whereas an upstream scheme has fewer and larger agents, downstream monitoring involves more players and thus higher costs.

Yet, downstream monitoring may yield significant public awareness benefits.

Nevertheless, from a transaction cost perspective, tradable permit programs should be monitored upstream. Besides, upstream holders of emission permits will shift their permit costs to the end-users who will be confronted with their polluting consumption via higher output prices anyway.

Enforcement comprises four stages (Tietenberg, 1985): detection of the violation, notification of the offender, negotiation about compliance measures and sanctions for non-compliance. The first stages are determined by the transparent nature of the permit traded. The last stages should set penalties high enough, in particular well above the marginal cost of abatement, to provide sufficient incentives for a high degree of compliance. If the penalties are not high enough, participants have an incentive to pay the penalties instead of buying permits.

The choice for upstream monitoring with fewer and larger agents seems at conflict with the demand for a liquid market. In other words, there is a trade-off between negotiation costs on the one hand, and monitoring costs on the other.

4.6.3.9. Compliance costs

If other regulatory systems are already in effect that oblige firms to compute their emissions, no additional compliance costs need to be made for determining whether permits need to be bought or sold. Reversely, compliance costs may arise if additional administrative requirements have to be fulfilled to comply with the permit system. These costs involve primarily recordkeeping which depends on the accuracy requirements by the environmental authority and the complexity of the commodity (permit) traded.

4.6.3.10. Conclusion

Three conclusions can be drawn from the transaction cost analysis. First, contrary to popular belief, set-up costs are relatively low and not a major impediment for the implementation of a tradable permit system.

Secondly, the amount of transaction costs incurred is largely determined by the design of the system, in particular the distribution and trading regime. To summarize, a tradable permit system implemented on a large scale, monitored upstream by an environmental agency that distributes tradable fuel permits of limited validity for free and that, without regulatory interference, sets up a brokered market using existing (internet) technology will entail far fewer transaction costs than a small system monitored downstream with permits auctioned off by an environmental authority that

subsequently strictly regulates a direct search market and that allows borrowing of emission rights.

Thirdly, permit trading creates a trade-off between some cost categories. While an upstream system saves monitoring costs, it may add to negotiation costs because the market is less atomistic. It should be pointed out, though, that there hardly exists a trade-off between transaction costs and efficacy. In conclusion, cap-and-trade programs do not need to suffer from prohibitively high transaction costs if they are smartly designed.

4.6.4. Transaction Cost Comparison

Does environmental taxation entail fewer transaction costs than emission permits and can it explain the overwhelming use of the former instrument? The introduction of a new policy instrument always poses serious problems for comparative assessment because such an analysis favors the status-quo. Mishan (1967) pointed out that the welfare derived from existing markets is simply better represented in both the social demand and supply curves. One method of evaluating the relative performance of alternative policy instruments is transaction costs analysis. This approach, however, tells us little about absolute performance. For example, a sure way of reducing transaction costs is to eliminate transactions. So, we rephrase our central question as *given* the objective that pollution has to be effectively curbed, which policy instrument entails the least transaction costs? To answer this question, we compare the same transaction cost categories.

4.6.4.1. Information and search costs

Although sometimes thought to be similar as “market-based” instruments, huge differences are ascertained in data collection necessary to run respectively an ecological tax system and a tradable emission rights program. Whereas a cap-and-trade system requires information about total pollution, environmental tax policy makers also need to assess damages, abatement costs and price elasticity to set the appropriate tax. Though these costs can be lowered by using a more easily observable tax base, this solution comes at a price: free-riding behavior will occur since the corrective tax loosens or looses its link with the source or victim of pollution.

4.6.4.2. Monitoring, enforcement and compliance costs

The time and energy spent on monitoring, enforcing and complying with environmental policy increases with the complexity of the rules. Unfortunately, complexity is often the corollary of accuracy. The relative ease of monitoring and enforcement is thus dependent on the transparency of the system, which, in turn, is determined by availability of information. By consequence, the costs of monitoring, enforcement and compliance are unmistakably higher for environmental taxation.

4.6.4.3. Negotiating and contracting costs

Taxes entail almost virtually no negotiation and contracting costs since environmental tax bargaining is rare. Trading in the market for emission permits, on the contrary, seems prone to substantial negotiation costs. However, brokers and auctions may not only reduce the search costs of buyers and sellers, but also their bargaining costs since they ensure that prices are publicly available. As explained before, the sale of a permit is a spot transaction that does not entail any contracting costs.

4.6.4.4. Administrative costs

Environmental taxes have yet another advantage. They can be administered and collected by the large, already existing and immensely experienced tax apparatus. These relatively small set-up costs can not conceal the substantial operational costs of tax collection. Administrative costs of permit trading are incurred through the creation of an environmental agency – if not in existence yet – and a distribution mechanism. The latter, however, need not lead to substantial costs when permits are distributed for free or by auctioning. Only grandfathering and updating are likely to entail significant set-up and operational costs.

4.6.4.5. Legislative costs

Finally, legislative costs are not a good decision criterion to adopt or reject one approach. Lobbying against the introduction of one system can be easily interpreted as rent-seeking in favor of the other. Moreover, lobbing costs are by large inversely proportional to public support costs.

4.6.4.6. Conclusion

All results are summarized in table 6. From this table, it can be inferred that tradable emission permits can give rise to significant transaction costs, but so may environmental taxes. While the former will provoke more set-up costs, the latter is burdened by information costs. Essentially, it all comes down to the appropriate design of the policy instrument. Whereas transaction costs of permit trading are dependent on the choice of the distribution and trading regimes, it is the definition of the tax base that determines the transaction costs of environmental taxation. So, it can not be concluded that taxation, by its very nature, entails fewer transaction costs than tradable permits. On the contrary, a well-designed permit trading system is likely to generate even fewer transaction costs (see table 7). A clever tax design may also save transaction costs, but, unlike permits, this can only be achieved at the expense of ecological efficacy.

Table 6: Comparative transaction costs of market-based environmental policy instruments.

Transaction costs	F*/V°	Environmental Taxation	Tradable emission permits
Information costs	F	**Very high** (pollution per source, damages, price elasticity)	**High** (grandfathering or updating) **Very low** (cap, free distribution or auction)
Search (planning) costs	F	**Very high** (emission and incentive taxes) **Average** (product charges) **Low** (user charges, indirect tax differentiation, income tax breaks)	**High** (banking and borrowing) **Low** (one year validity)
Negotiation costs	F	**Very low** (tax packages)	**High** (direct search market) **Low** (brokered or dealer market) **Very low** (auction market)
Contract costs	F	**Non-existing**	**Zero** (spot transaction)
Set-up costs	F	**Very low** (existing tax administrations)	**Average** (existing technology) **Low** (free distribution)
Monitoring and enforcement costs	V	**High** (emission and incentive taxes) **Average** (product charges) **Low** (user charges, indirect tax differentiation, income tax breaks)	**High** (downstream) **Low** (upstream)
Lobbying costs	F	**High** (industry con, bureaucrats pro) **Low** (environmentalists, politicians)	**High** (free distribution: industry, right wing coalition) **High** (auction: bureaucrats, environmentalists, left wing coalition)
Public support costs	F	**High** (treasury) **Average** (earmarked revenues) **Low** (environmental tax reform)	**High** (auction) **Low** (free distribution)

Operational costs	V	**High** (tax personnel)	**High** (grandfathering, averaging) **Average** (auction) **Low** (free distribution)
Compliance costs	V	**High** (tax forms)	**Average** (permit register)

* = fixed, ° = variable

4.6.5. Policy implications

The main characteristics of a cap-and-trade program are its efficacy and static and dynamic efficiency. By setting a cap, the system imposes a physical upper limit on the total amount of pollution. Because no more pollution rights are distributed than the overall cap allows, the system, by definition, always meets its goal. In other words, installing a quantitative cap is the most effective way of curbing environmental pollution. Polluters can meet their environmental obligations by complying with their emission allowances, buying additional emission permits, or investing in emission reduction. Since some can abate pollution more cheaply than others, the latter will choose to buy emission rights from the former. It would be inefficient to impose the same emission rules on all agents. The market price for emissions gives polluters a clear incentive to search for permit cost reductions through cleaner technology. Therefore, tradable permits also yield dynamically efficient outcomes.

Information deficiencies render environmental taxation neither very effective, nor efficient. However, since policy-makers are more familiar with taxes than with tradable rights, they tend to believe that the implementation of environmental taxes is less complicated and entails fewer transaction costs, particularly set-up and negotiation costs. The comparative analysis of transaction costs presented in this chapter clearly refutes this argument.

Transaction costs pose additional considerations in the design and comparison of policy instruments. For example, whereas the free distribution of emission rights minimizes administrative costs, the auctioning of permits is likely to eradicate negotiation costs by bringing buyers and sellers together and revealing permit prices. So, while not suitable for the *initial* distribution, auctions (as well as brokered markets) have an important role to play in the allocation of *excess* permits. Market transparency asks for a sufficiently large area to be implied in the program. To counter the subsequent signaling and monitoring costs, the environmental authority should facilitate auctions or brokered markets and monitor the system upstream.

Table 7 reveals that, from a transaction cost perspective, the optimal tradable permit system is a large scale, upstream operation in which the environmental agency distributes the permits for free at the beginning of each year and ensures that excess permits can be sold via a brokered market or auction. Table 7 also shows that user charges, indirect tax differentiation for environmentally friendly products and income tax deductibles for environmentally friendly behavior entail the least transaction costs, yet more

than the optimal tradable permit scheme. Moreover, these instruments are hardly as effective.

Table 7: Transaction Cost-effective Environmental Market-based Policy Instruments

Transaction costs	F*/V°	Environmental taxation	Tradable emission permits
Information costs	F	**Very high** (pollution per source, damages, price elasticity)	**Very low** (cap, free distribution or auction)
Search (planning) costs	F	**Low** (user charges, indirect tax differentiation, income tax breaks)	**Low** (one year validity)
Negotiation costs	F	**Very low** (tax packages)	**Low** (brokered or dealer market)
Contract costs	F	**Non-existing**	**Zero** (spot transaction)
Set-up costs	F	**Very low** (existing tax administrations)	**Low** (free distribution)
Monitoring and enforcement costs	V	**Low** (user charges, indirect tax differentiation, income tax breaks)	**Low** (upstream)
Lobbying costs	F	**High** (industry con, bureaucrats pro) **Low** (environmentalists, politicians)	**High** (free distribution: industry, right wing coalition)
Public support costs	F	**Low** (environmental tax reform)	**Low** (free distribution)
Operational costs	V	**High** (tax personnel)	**Low** (free distribution)
Compliance costs	V	**High** (tax forms)	**Average** (permit register)
Total costs		**Low fixed** costs of less effective taxes, still **high variable** costs	**Low total** costs

* = fixed, ° = variable

However, the choice between tradable permits and emission taxes can only be made when case-specific factors are taken into account. Which instrument is best, depends upon a variety of characteristics of the environmental problem: social legitimacy, political feasibility, economic impact and regulatory context. Furthermore, transaction costs are historical costs. What are prohibitively high costs today (for instance, information costs), need not be prohibitive tomorrow (for instance, because data collection has improved). So, transaction analysis needs to be complemented by cost-benefit or cost-effectiveness studies. Certainly, the argument that tradable emission rights are effective, but entail prohibitively high transaction costs can no longer be maintained.

5. Tradable entry rights versus road pricing[123]

5.1. Introduction

In the previous chapter, it was demonstrated that emissions trading can be environmentally effective, economically efficient, flexible and designed so as to limit unwanted distributive aspects. However, although some countries are developing domestic permit trading initiatives, governments tend to favour emissions taxes because they are considered to have lower transaction costs than permit trading. We have dismissed this view based on a comparative transaction costs analysis.

The effectiveness of permit trading is considered to be guaranteed in a permit trading scheme because emission sources operate under an emission ceiling and this ceiling is assumed to be lower than business-as-usual emissions. The transportation industry not only struggles with pollution problems and greenhouse gas emissions; also problems such as congestion, noise and traffic accidents are important issues related to transport. A cap-and-trade system could offer a solution to some of these problems. This chapter focuses on the potential use of tradable rights systems in the transportation industry in order to achieve more sustainable transport.

The chapter is organized as follows. First, the context of the transport sector is discussed. More specifically, the main arguments for and against the use of tradable permits in the transport sector are analysed and relevant areas are identified. Secondly, three different tradable transportation rights (TTR) scenarios are distinguished, namely tradable vehicle kilometre permits (TVKP), tradable fuel permits (TFP) and tradable entry permits (TEP). Then, the evaluation criteria of the scenarios are given. In the following section, these scenarios are developed and evaluated with special attention to the initial distribution of the permits, temporal and spatial flexibility, monitoring and enforcement issues and the acceptability of the system. An important obstacle of tradable transportation rights would be the prevalence of prohibitively high transaction costs. Consequently, a comparative analysis is conducted in which the transaction costs of tradable entry permits are compared with those of road pricing. Finally, we will conclude by formulating policy implications.

5.2. Transportation industry context

5.2.1. General observations

In our modern world, sustainable development has become an issue of worldwide concern. The E.U., for instance, has stated that sustainable development must be the central goal in all policies (European Commission,

[123] Part of this chapter has been published as: Crals and Vereeck, (2003); Crals, Keppens and Vereeck, (2004); Crals, Keppens and Vereeck, (2004b); Keppens, Crals and Vereeck, (2004) and Crals and Vereeck (2005b)

2001). The standard definition of sustainable development is: 'meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report, 1987). It is a strategy that requires the integration of economic growth, social equity and environmental management. This idea of sustainable development was spurred by a gradual change due to unsustainable economic policy. Meteorological observations show that since 1900 the European average annual temperature has increased with 0.3 to 0.6°C. Furthermore, climate models predict a further increase of approximately 2°C in 2100 compared to 1990 levels. The European Environment Agency (1998) claims that the greenhouse effect will cause the Arctic ice to smelt, increasing sea and ocean levels by 1-2m; thus flooding many parts of the world like Bangladesh and the Netherlands. To make sure that the further increases in temperatures are limited to maximum 0.1°C each decennium, the industrial countries have to limit their greenhouse emissions (Carbon Dioxide (CO_2), methane,…) by the year 2010 with at least 30-55% compared to the level of 1990. These reductions are much higher than agreed in the Kyoto protocol[124]. It is unlikely that the E.U. will achieve these CO_2-reductions since the most recent 'business-as-usual' scenario of the European Commission (made before Kyoto) indicates an increase in CO_2 emissions of about 8%, with the largest increase in the transport sector (39%)[125] (European Environment Agency, 1998). In addition, measurements have indicated that transportation accounts for more than half of the very fine particulate matter[126], a major public health concern[127] (Dayomi, 2000, p.4). Since these trends are not sustainable, the necessity of a sustainable transport network is obvious. The OECD (2002) forecasts that traffic growth (in vehicle kilometres travelled) is such that the current strategies will be inadequate to reduce the overall emissions over the coming 30 or 40 years. Reducing overall emissions will only be possible by combining technical solutions for reducing emissions (for instance the usage of Intelligent Transport Systems[128]), enhancing the energy efficiency of engines and managing demand.

To summarize, there are several reasons why negative externalities of transport and traffic receive often such a prominent place in the public debate (Nijkamp, 1999, p. 552):

---

[124] Under the Kyoto Protocol, the industrialized countries must reduce their emissions by at least 8% below 1990 levels within the commitment period 2008-2012.

[125] In most industrialized countries, the transport sector is one of the most significant greenhouse gas emitter and particularly of CO_2, the main greenhouse gas associated to transport activity (for instance 34% of CO_2 in France in 1999, 30% of CO_2 in the US in 1997) (Raux, 2002, p. 143).

[126] Particulate matter (PM) is the general term used for a mixture of solid particles and liquid droplets in the air. These particles originate from both stationary and mobile sources and also from natural sources.

[127] Transport accounts for 49% of carbon dioxide emissions, 50% of nitrogen oxide emissions, 34% of carbon monoxide emissions, 30% of hydrocarbon emissions and 9% of particulate emissions.

[128] Intelligent Transport Systems involve the application of information, communication and control technologies for the collection, processing, integration and supply of information to enable authorities and operators to improve the operations of transport systems and to enable individual users of the transport system to make better informed, i.e. more intelligent, transport decisions.

– The transportation sector has an important structuring impact on the spatial economy;

– The transport infrastructure is collective in nature and regarded as a public goods characterized by the non-excludability postulate;

– Traffic and transport have often an important strategic, sometimes political and military meaning which far exceeds local interest;

– Transportation infrastructure is often supplied in indivisibilities, so that there is an obvious scope for natural monopolies; and

– Mobility and transport generate a variety of unpriced effects which show up as social costs in other segments of society (e.g. noise annoyance).

Altogether, there is a broad-based perception that the position of transportation and mobility in the light of broader and ecological objectives is problematic. It is therefore no surprise that new policies are necessary in the concept of sustainable transport. Raux (2002, p. 147) distinguishes two main criteria that can be used for judging the relevance of permit systems in the transport sector. These are, on the one hand, the ability to impose a constraint or a right defined in a quantitative manner within a specified space-time, and, on the other hand, the ability that agents have to transfer all or a portion of these quantitative obligations. Permit systems are of particular interest in following cases:

– Where a given environmental performance must be achieved in a context of uncertainty over agents' price response functions[129];

– Where agents are more sensitive to quantitative signals than to price signals[130];

– Where local and regional problems arising from transport activities are targeted; and

– When permits can be allocated for free, this enhances the acceptability of the new instrument.

In general, the introduction of a tradable permit system in road transport or tradable transportation rights (TTR's) serves two purposes, namely:

1. To effectively cap global environmental harm caused by road transport; and
2. To efficiently internalize the environmental costs by setting the right price for TTR's.

The latter aim depends in turn on the number of participants, the transaction costs, hence the liquidity of the market for TTR's (Noll, 1981). One obstacle, indeed, would be the prevalence of prohibitively high transaction costs. When a market participant has substantial search and negotiation costs, it will lead to fewer transactions and, finally, undermine the functioning of the market. Moreover, prices will not accurately reflect marginal values. Specific attention will have to be paid to setting up a

[129] In such cases, a permit system is more likely to achieve a quantitative objective than taxation.

[130] This depends on the price elasticity of the demand. This will be discussed in more detail in the following subsection.

transparent, atomistic market. Alternatively, the efficiency of the market also depends on the administrative costs of the TTR system which increases with the number of participants. Much depends on the technology that is used (Raux, 2002) and the monitoring approach. In an upstream system, the regulatory and market authority monitors producers, while policing in a downstream system focuses on end-users. It is easy to understand that an upstream system has far fewer and larger agents leading to lower administrative costs. Finally, the relevant market has to be defined since the relationship between emissions and pollution is not always straightforward. Pollution at a given point in time and space is the likely consequence of many emissions from several locations and their interaction. Dobes (1999) points out that this is particularly true for transport. The transport sector is different from other sectors where tradable permits have been used to date. First of all, transport is not a homogeneous good. Modes and nature of trips vary and so does the pollution caused by them. Likewise, transport not only generates environmental damage by emitting CO_2 and small particles, but also other negative externalities such as congestion, noise and road accidents. Since public road infrastructure is heavily subsidized, it is reasonable to argue that the transport market is distorted. Secondly, compared with other industries where tradable permits have been used, transport systems involve mobile, rather than fixed sources of emissions. Finally, the domestic transport sector provides a non-tradable service. Of itself, its output can not be produced overseas as a substitute for domestic production of transport services (Dobes, 1998). However, it could affect other sectors from which demand for domestic transport services is derived.

5.2.2. Prices versus quantities in case of inelastic demand

The idea that road users should be charged their marginal external costs is a widely accepted principle in the economic as well as in the transportation literature (Crals, Keppens and Vereeck, 2004, p. 122). However, while analysts see road pricing as an attractive policy tool, most attempts[131] to introduce economic incentives of this type in the transport sector have failed. These failures may mostly be due to the fact that the public does not support these measures, but empiric research[132] also suggests that the inelasticity of the demand makes it difficult to introduce the appropriate price incentives (Graeme, 2001). In principle, tradable permits achieve the same result as taxes. Whereas a tax sets a price and leaves regulated entities to adjust the quantity, a tradable permit system sets a quantity and the price adjusts according to the resulting supply and demand for permits. We will analyze if inelastic demand exists in the transport sector and if so, whether prices or quantities are preferred.

Some empirical studies have tried to calculate relevant price elasticity's in the transport sector. TRACE (1998) and de Jong and Gunn (2001)[133] have

[131] The introduction of road pricing in the Netherlands has failed while road pricing measures in Germany seem to have been postponed. Austria, in contrast, in contrast, was successful in implementing a road pricing scheme in 2004.

[132] For empiric research about the inelasticity of the demand for car use and fuel, we refer to Glaister and Graham (2002a).

[133] They reviewed evidence from more than 50 recent studies (1985 and later) for Member States of the European Union, reporting average unweighted values of short- and long-run elasticity's for car trips and car-km. The short-run included only mode choice effects; the

provided comprehensive and up-to-date surveys of car time and fuel price elasticity's of car travel. Regarding the effects of changes in fuel price, they found that in the short-run, car trips and car-km respond in much the same way. The short-run fuel price elasticity was –0,16 for both car trips and car-km. In the long run, the elasticity of car-km to fuel prices increases quite substantially, to -0,26, but only marginally for car trips (-0,19). Thus, the immediate consumer response to a fuel price change is to modify the number of trips made, but over time they make even more substantial changes to the distance traveled[134]. In general, comparing the fuel price and car time elasticity's, de Jong and Gunn's results show that in the long-run the elasticity of car-km with respect to car time is much higher than the elasticity of car-km with respect to fuel price. Regarding fuel demand elasticity, Graham and Glaister (2002a) surveyed the international literature on fuel demand[135]. Their findings can be summarized as follows: weight of evidence in the literature suggests that the long-run price elasticity of demand for fuel falls between -0,6 and -0,8, and the short-run elasticity between -0,2 and -0,3 (Graham and Glaister, 2004, p. 270). In conclusion, it is fair to state that the demand for fuel, car trips and car-km is rather inelastic (Crals and Vereeck, 2004b).

In practice, price elasticity has an influence when choosing between taxes and tradable permits. Probably the most important feature of a tradable permit scheme is that it achieves a specific goal by specifying the cap that will be allowed in total. By contrast, to secure a quantity target with a tax, there must be fairly certain knowledge about the relevant price elasticity's of demand for energy, transport, etc. More specifically, tax elasticity τ is defined as:

$$\tau = \frac{t}{p}\ \varepsilon; \qquad (1)$$

with ε being the price elasticity, t the tax rate and p the price. The tax elasticity indicates the percentage at which the demand of energy will be reduced if the tax rate is increased by one per cent. Schöb (1996) uses the first order condition of household maximization[136], inserts the tax elasticity into a rearrangement of the first order equation[137], and solves for the optimal tax rate t^*, which leads to:

---

long-run included some combination of mode choice, destination choice, travel frequency choice, relocation of population and retail and service activities.

[134] de Jong and Gunn (2001) argue that this may be due to adaptations in some combination of mode choice, destination choice, relocation of population and retail and service activities

[135] Graham and Glaister (2002b) gathered a literature survey of 113 studies published between 1966 and 2000, and collected 1083 fuel demand related elasticity estimates.

[136] The first order condition as shown by Schöb is: $\frac{\partial W}{\partial t} = (MB - p - MED + \delta \cdot R')\frac{\partial x}{\partial t} = 0$. The marginal environmental damage is noted by *MED*, *R* represents the tax revenue, δ is the marginal excess burden and W the social welfare function. For a complete analysis of the tax elasticity we refer to Schöb (1996). We use this analysis to prove that knowledge about price elasticity's is necessary to reach a certain target when using taxes.

[137] Rearranging the equation from footnote 134 gives: $MB = p + MED - \delta \cdot R' = p + MED - \delta \cdot (t + x \cdot \frac{\partial t(x)}{\partial x})$.

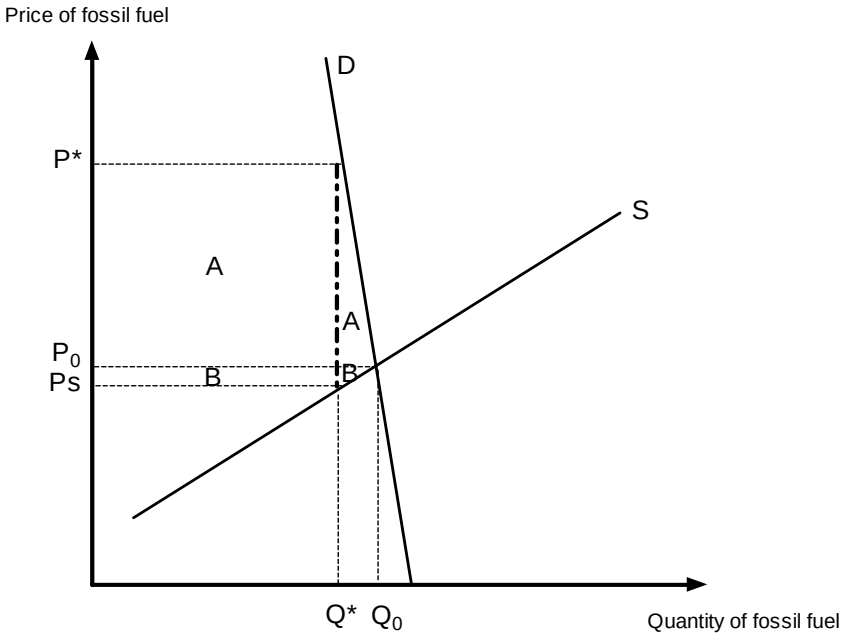
$$t^* = \frac{MED}{1+\delta.\left(1-\frac{1}{\tau}\right)}. \qquad (2)$$

Equation (7) shows that the optimal tax rate is a function of the marginal environmental damage (MED), the marginal excess burden of the rest of the system and the tax elasticity (which in turn depends on the price elasticity as shown in equation (1))[138]. In general, goods and services for which demand is inelastic should have a high tax rate since charging their prices does not create much distortion. Conversely, the government should set lower tax rates on price-elastic goods since small price changes may create large distortions in the quantity demanded (Gentry, 1999, p. 307). Therefore, price elasticities should be known before setting a tax rate in order to induce the right incentives from the tax system.

Conversely, tradable permits pose a cap on the use, irrespectively of the price elasticities. When a permit system is introduced, the regulated item becomes scarce and the cost (inclusive of the permit) rises. This rise in cost will evidently lead to a rise in the price. The change in price depends on relative elasticities of supply and derived demand. In general, long run supply elasticity will be higher than the short run, because producers can adapt their behavior. The elasticity for demand depends partly on all the possible ways that downstream producers and consumers can reduce their use through i.e. fuel switching, increased fuel efficiency and changes in consumption (Cramton and Kerr, 2000). For example, figure 4 illustrates how tradable permits reduces the quantity from *Q0* (uncontrolled fossil fuel demand) to *Q** (carbon cap translated into a fossil fuel cap) and raises the price of fossil fuel. It is also clear that, as fossil fuel becomes restricted, the price buyers pay rises to clear the market, and the price suppliers receive falls. The permit price is the difference between these prices. The social cost is the sum of the loss of consumer and producer surplus (*B*). Consumer surplus is measured as the area under the demand curve (*A*) to reflect the amount that consumers would be willing to pay to have the price lowered to its original level. The demand in this example is highly inelastic meaning that prices will raise substantially.

[138] The optimal tax rate is different from the Pigouvian tax because this is completely determined by the marginal environmental damage. However, the Pigouvian tax turns out only to be optimal in two circumstances. First, if there is no distortion of the tax system (i.e. $\delta=0$) and second, when, at optimum, the tax elasticity is equal to unity. However, this is rarely the case and therefore we will not further elaborate on Pigouvian taxes.

Figure 4: Price of fossil fuel with inelastic demand



Source: Based on Cramton and Kerr (2002).

Concluding, taxes as tradable permits will both induce an equilibrium price in case of inelastic demand. However, when establishing taxes, this price inelasticity needs to be known ex ante, while a permit system sets a quantity and the price adjusts without information about relevant price elasticities. Consequently, information costs of taxes are much higher than those of tradable permits in case of inelastic demand.

In addition, elasticity of demand and supply is a determining factor in discussing the incidence of the regulated cap, i.e. who bears the true burden of tradable permits and taxes[139]. In general, the incidence depends upon the relative elasticities of demand and supply. The burden is shifted forward to consumers if the demand is inelastic relative to supply; the burden is shifted backward to producers if supply is relatively more inelastic than demand. For example, in case of mineral oil prices in small countries where the price elasticity of demand is low, the consumers have to bear the costs because the consumer price of these products is determined by the prices on the international spot markets. In contrast, if the price elasticity is high, only a small part of the burden of an environmental measure which increases the production costs of a good can be passed to the consumers. Thus, the producers, shareholders, managers as well as workers of these firms have to bear the costs (Schneider and Weck-Hannemann, 2003, p. 2).

5.3. Tradable transportation rights

[139] By incidence we mean the ultimate economic effect of taxes on the real income of producers or consumers.

The global of transportation activity is the result of a combination of factors relating to land use (location of activities and consequences for distances traveled), the supply of infrastructure and services (price and quality of service for different modes of transport), technical features of transport vehicles (energy source, unit consumption and emissions) and the intensity of vehicle use (mobility as a function of economic and social trends). These factors all offer potential fields of action for controlling nuisances in the transport sector (Raux, 2002, p. 148-149). However, we will focus on three scenarios[140] of tradable transportation rights because of different objectives. Then, we will discuss the evaluation criteria which will be used for the assessment of the expected efficiency of the three scenarios.

5.3.1. Potential for permit programs in the transportation industry: three scenarios

First, we give a comprehensive review of the possibilities to introduce a tradable permit scheme for the use of road infrastructure. The possible permit schemes are based on Hau's (1992) classification of road use charges. The following table illustrates the possible charging and tradable permit schemes.

Table 8: Methods to regulate road use

Target	Charging Scheme	Tradable Transportation Rights
Vehicle Ownership	Registration tax Annual licence fee	Vehicle ownership permits
Vehicle use	Fuel Tax Tax on vehicle parts	Fuel permits Vehicle Kilometre permits
Place & time of vehicle use	Parking charge Supplementary licensing[141]	Parking permits Driving days permits
Vehicle use, place & time	Differential fuel taxes	Differentiated Fuel Permits
Point charging	Tolling, road pricing and cordon-based pricing	Entry permits or corridor permits
Continuous charging	Congestion based charging	Differentiated vehicle kilometre permits

Source: Based on Keppens and Vereeck (2004)

Vehicle ownership permits challenge the dominance of the car culture, the possession of private cars and reincarnates the culture of public transport. A well-known system of vehicle ownership permits is functioning in Singapore. The basic purpose of a tradable fuel permits system is to achieve an environmental goal, namely reduction of CO_2 emissions caused by cars. The tradable vehicle kilometre permits system sets an upper limit based on the total vehicle kilometres of a reference year which are allocated among all participants. Tradable differentiated vehicle kilometre permits have two objectives. Besides a reduction of car use, more specifically during peak

[140] There are various definitions of scenarios. The following definition, which covers all aspects of scenario development may be useful (Nijkamp et al., 2004, p. 293): 'a scenario describes the present situation in (segments of) society, together with likely and desirable future states of this society, and series of events (or transition paths), which may connect the present situation and future states of society'. Consequently, scenarios enable us to reduce complexity and facilitate decisions about future events by arranging and classifying information and preventing information overload. Ideally, scenarios may help us to gain insight into the consequences of various strategies and enable us to compare them.

[141] E.g., Singapore Area Licensing Scheme

hours in congested areas, this system also aims to reduce the emission level caused by private road transport. Tradable corridor permits aim to solve the problem of traffic congestion on major highways while tradable entry permits (or cordon permits) set an upper limit on cars driving into an urban area. Tradable parking permits have a limited geographical scope and apply only to employees of individual firms, industrial zones or school campuses. Verhoef, Nijkamp and Rietveld (1997) explore also the possibilities of using tradable permits on the supply side (automobile and fuel industry). This can also be categorized as upstream permits. These types will not be further discussed because a rather insignificant change in car use can be expected, although they can have considerable environmental gains.

Secondly, three types of tradable transportation rights are discussed and it is indicated why these types are chosen. The first scenario involves controlling vehicle use and is focused more precisely on vehicle kilometres traveled (Tradable Vehicle Kilometres Permits or TVKP). As already pointed out, the OECD (2002) forecasts that traffic growth, in vehicle kilometres travelled, is such that the current strategies will be inadequate to reduce the overall emissions over the coming 30 or 40 years. Consequently, the goal of this system is to limit total vehicle kilometres travelled. Disadvantageous is that it neglects other problems like congestion and noise. The most common approach to noise control is still through regulation or funding for acoustic protection around transportation infrastructure. With respect to congestion, control is still achieved essentially through the waiting line, despite the ongoing and long-time debate about congestion pricing (Raux, 2002, p. 149).

The second scenario concerns total fuel consumption by vehicles, and focuses more specifically on CO_2 emissions (Tradable Fuel Permits or TFP). In the year 2000, transport related CO_2 emissions had increased by 128 million tons or 18% compared to 1990 (European Environment Agency, 2002). CO_2 emissions by passenger cars account for 50 % and are forecasted to become twice as big in 2020 in spite of the increasing fuel efficiency of modern engines (Commission of the European Communities, 2003). This is due to the production of larger and faster cars with more energy consuming accessories as well as changing driving conditions (e.g. road congestion). Without effective policy measures, CO_2 emissions are expected to grow further. In the past, the cornerstone of the European strategy to reduce CO_2 emissions was an environmental agreement with the car industry to improve fuel efficiency. In 1995, the European Automobile Manufacturers' Associations (ACEA) committed themselves to realize an average CO_2 emission value of 120 g/km for all new cars, if possibly by 2005 and at the latest by 2010. In 1999, the EU recommended a CO_2 emission target of 140 g/km and postponed the previous target (Commission of the European Communities, 1999). However, these agreements are unlikely to lead to the desired reduction in CO_2 emissions. It is expected that even with full implementation of the ACEA agreement, a growth of 11 % CO_2 emissions is still to be expected (without the agreement, emissions would increase by 29%) (European Environment Agency, 2001). This steady rise is due to an increase of car mileage and ownership per capita and the use of more powerful engines. Therefore, to reach the targets imposed by the Kyoto Protocol, complementary policy measures need to be taken. The European

Commission's expert group on transport and environment states (Commission of the European Agency, 2000):

> "A CO2 tax can lead to suboptimal outcomes if it is used as a single instrument. […] It may be difficult to find the tax level that actually leads to the emission reduction required."

Instead, the expert group considers emissions rights trading as a more promising policy approach for all or parts of a country's sources emitting CO_2 mainly because the system is cost-effective[142]. The group further emphasizes that permit trading should focus on the end-user, i.e. the single car driver.

In the third scenario, we focus on urban transport (Tradable Entry Permits or TEP). Suburbanization and reduction of urban density, the increase of car ownership and the expansion of the road network have made the car the prevailing urban transport mode. This evolution causes not only congestion, but also safety and environmental problems. Because road network supply at present does not meet the demand, a reduction of the use of private cars in the city seems desirable. The idea that road users should be charged their marginal external costs is a widely accepted principle in the economic as well as in the transportation literature (Button and Verhoef, 1998). The focus has been mainly on pricing mechanisms: cordon and congestion pricing, variable taxation and other taxes. Internalizing the congestion externality by means of tolling was already recognized by Dupuit in 1844 and well-founded by economists like Pigou in 1912 and Knight in 1924. However, as discussed by Jones (1998), most attempts to introduce economic incentives of this type in the transport sector have failed. These failures may partly be due to the technical difficulties of introducing the appropriate price incentive but politico-economic reasoning also suggests that road pricing is rarely adopted because the public does not support these policy measures. More recently, the introduction of road pricing measures in Germany seems to have been postponed due to technical difficulties. Austria, in contrast, was successful in implementing a road pricing scheme in 2004, but the measures hardly differentiate with respect to ecological characteristics. In addition, the revenues are earmarked for financing road infrastructure. To counter these disadvantages of road pricing, we will discuss a system of tradable entry permits.

5.3.2. Evaluation criteria

For the assessment of the expected efficiency of the three scenarios, we will use as a leading principle that the more the scheme differentiates, or at least lends itself to differentiation, in accordance with the various dimensions that determine the marginal external costs of road trips, the higher its

[142] In July 2003, European parliament adopted a directive that creates a trading program in greenhouse gas emissions rights for energy intensive industries within the EU (European Commission, 1995). Operating on a European instead of a national scale increases the number of participant and reduces the costs because it increases market liquidity as well as the market for low emissions technology. Six greenhouse gases are included in the scheme. The program is estimated to cover about 46% of the EU's total CO_2 emissions by the year 2010. Starting a three year try-out period in January 2005 (with legal enforcement from January 2008 on), approximately ten thousand companies are involved. The chemical industry is excluded since it is a relatively small player in CO_2 emissions.

effectiveness. The following table gives a rough idea of these dimensions (Verhoef, Nijkamp and Rietveld, 1997, p. 536). This table can be a helpful instrument in assessing the expected effectiveness of the various schemes discussed in the following paragraph.

Table 9: Dependence of various marginal external costs of road usage on various trips characteristics

Marginal external cost	Trip Characteristic			
	Mileage	Time of driving	Area of driving	Vehicle used
Environmental externalities	***	*	**	***
Noise	***	**	***	***
Safety	***	**	**	*
Congestion	***	***	***	*

* relatively weak dependence, ** moderate dependence, *** relatively strong dependence

Source: Verhoef, Nijkamp and Rietveld (1997, p. 536)

As indicated in the table, each of the marginal external costs depends on the mileage. Environmental externalities are in addition strongly related to the vehicle used. As the type of vehicle, there is also a relatively strong dependence between noise and area of driving. External safety costs of accidents may to some extent depend on the area and time of driving. An individual's contribution to congestion externalities is strongly dependent on time and area of driving. Verhoef, Nijkamp and Rietveld (1997) also mention that driving style is an important factor that makes actual external costs differ across individual road users.

5.4. Scenarios

We will discuss three different types of tradable transportation rights and design them following some specific characteristics. The choice of these characteristics is based upon the already existing cap-and-trade programs, such as the U.S. Acid Rain Program and the California RECLAIM program as described in the fourth chapter. These programs have proven that emissions trading have considerable potential in practice, as well as in theory. Also the framework developed by Harrison (1999, p. 24-25) provides a useful tool in the design process. He identifies three subsequent steps:

1. Threshold issues which include decisions regarding the basis purpose and nature of the program:

– Purpose of the system;

– Geographic area; and

– Nature of the commodity traded (distinction between cap-and-trade programs and credit based systems).

2. Design issues which include the decisions that arise as the program is designed and turned into a specific regulatory program:

– Geographic and temporal flexibility (i.e. banking and borrowing);

– Institutional framework (the possibility that third parties, for example brokers, participate or setting up an auction or another institution to increase liquidity and establish market prices);

– Initial distribution of rights (only relevant in cap-and-trade programs); and

– Sources that are required or allowed to participate (possibility to 'opt in' to the program).

3. Implementation issues which include the decisions that come to the fore as the program is implemented:

– Certification of permits (for credit-based programs);

– Monitoring and reporting of emissions;

– Determining compliance and enforcing the trading program; and

– Maintaining and encouraging participation (encourage participation of sources whose participation is optional).

Although these categories are clearly interrelated, they provide a useful way of organizing the many specific elements and decisions that must be made to develop concrete programs.

5.4.1. Tradable vehicle kilometre permits

A tradable vehicle kilometre permits (TVKP) system restricts the number of vehicles kilometres allowed to drive. First, the different design elements are discussed and secondly, the system is evaluated.

5.4.1.1. Design

The design elements are based on the framework developed by Harrison (1999, p. 24-25).

Threshold Phase

TVKP intend to limit the amount of vehicle kilometers in the European Union, with a clear focus on the car. Implementing the system on a European scale increases the number of market players and vindicates the free movement of goods and persons in the European Union. For reasons of acceptability and feasibility, trucks and heavy duty vehicles are not included in the system. The cap is set on the total amount of car kilometers of the reference year, 1998[143].

Design Phase

Because of the social dimension of mobility, permits are distributed for free. Consequently, the system does not necessarily imply an additional tax because only individuals who need more permits than initially received have additional costs. Furthermore, the system allows some freedom at

[143] The goal of the common transport policy in the E.U. is to deal with the increasing congestion and to encourage more environmental friendly transport modes. Furthermore, the E.U. wants to comply with the Kyoto commitments. However, Kyoto is only a first step. Thereafter, the E.U. should aim to reduce atmospheric greenhouse gas emissions by an average of 1% per year over 1990 levels up to 2010. Another goal is to shift road transport to transport by rails, water and public transport, to achieve that the share of the road transport in 2010 will not exceed that of 1998. This explains the choice for 1998 as a reference year and implementation on a European scale.

individuals because they can choose between buying additional permits or changing their behavior and choosing other transport modes. Therefore, public support is expected to be larger in comparison to a traditional tax system. In principle, the distribution of permits can occur at different times, for example in the beginning of the calendar year or together with the tax declaration. Moreover, the free distribution of the permits can be based on different criteria:

- Age, for example 0-18 year, 18-64 and 65+. These age categories have a clear link with economic activity[144];
- Location in order to, for example, induce people to live in the city centre by allocating them more TVKP;
- Income in order to reduce social inequality;
- Economic activity, for example active, non-active and retired population;
- Family situation. A distinction can be made between singles, families without children, one child, etc.

These distribution criteria can be evaluated based on criteria such as need, social equality, environmental planning etc. We choose for TVKP to be distributed based on age, divided up in three age categories because of the link with the social activity of the population which has an important influence on the demand for transport.

The validity of a permit is set on one year. Banking and borrowing is not allowed mainly because, in case of banking, the tradability can show a cyclical pattern. Borrowing is not allowed because individuals will not be forced to change their behavior if they can keep borrowing rights.

Implementation Phase

For the creation and organization of a TVKP system, a European institution needs to be established. This institution has three important responsibilities. First, it has to allocate the TVKP at the national bureaus, according to the population of every country for each age category. Secondly, it has to monitor the national bureaus on correct enforcement of the TVKP system. Finally, it is responsible for the creation and organization of the auction. Individuals, who do not need their yearly allocated TVKP, can use this auction to sell their excess permits at the price of that day.

In the start-up phase, permits are allocated at all individuals on January, 1 which are valid until their birthday (in terms of percentages). Permits are again allocated on everyone's birthday. The state register office is responsible for this distribution because they dispose of the necessary information. Although the population is entitled to a certain amount of yearly rights, these are allocated on a monthly basis. A yearly distribution can cause namely prices to fall at the end of the year as individuals save up

[144] This is assuming that compulsory education exists until the age of 18 and retirement is possible starting at the age of 65.

their permits[145]. Transit traffic will be obliged to buy a 'travel vignette' when entering the European Union[146].

The monitoring will occur downstream, at the level of the different consumers. Unmanned cameras will monitor whether the registration system is activated in every car. Furthermore, cars will be checked at the yearly motor vehicle inspection and by unexpected police controls. Sanctions have a deterrent effect, which will induce individuals to avoid violations. These sanctions need to be determined ex ante and exceed the costs of compliance considerably.

The technology needed to make a system of TVKP feasible has some specific requirements:

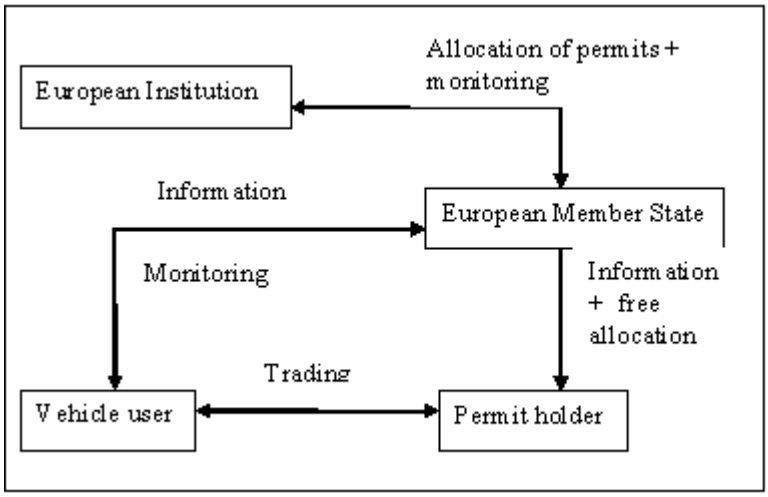
1. Registering kilometres traveled (on-board unit);
2. Differentiated introduction, meaning that the system needs to be applicable:
   - In a pilot project;
   - On the entire road network; and
   - For each European road user.
3. Privacy: the anonymity of the car users needs to be guaranteed. This requires only registration of non-compliers and not of every vehicle user[147].

In a TVKP system, four different parties can be distinguished:

1. A European institution;
2. The E.U. Member States;
3. The permit holders; and
4. The vehicle users.

[145] Individuals can misjudge their own situation, as a result of what they can have excess permits at the end of the year.
[146] This is already necessary in some European Countries, i.e. the "Autobahnvignet" in Austria.
[147] The registration of time and/or place also disrespects the privacy of the car users.

Figure 5: Operation of TVKP



The model comprises six processes:

1. A European institution allocates the rights to the E.U. Member States;
2. This European institution also monitors the Member States;
3. The Member State informs the permit holders and the vehicle users;
4. The Member State distributes the permits among the population;
5. The permit holder trades the right with the vehicle user; and
6. The vehicle user is monitored by the Member States.

The rights are materialized by means of a smart card. Because of the uniformity of the on-board unit, this system can also be used for other transport modes. The calibration, monitoring and installment of the on-board unit can be performed by an existing authority, for example the department responsible for the registration of vehicles and license plates. It is also possible to differentiate the type of on-board unit according to vehicle type, such as environmental performance. Moreover, the possession of an on-board unit can be linked with the state register number of the owner[148].

The monitoring aspect has the following characteristics:

- The memory in the smart card registers the transactions which can be monitored when recharging the card. Furthermore, by checking if all vehicle users have a permit account, fraud can be traced;
- The on-board unit should register all kilometres traveled. The functioning and calibration of the on-board unit is checked at the yearly motor vehicle inspection.
- The cameras serve as monitoring tools.

Finally, the TVKP system is proposed to the public by conducting a marketing campaign. This means that all media (radio, television, written press and internet) are used to inform the public. Permit holders and vehicle users will be explained their rights and duties in the TVKP system. Also an info-desk and info-line will be set up to answer questions.

[148] A license plate is often also connected with the state register number of the owner.

5.4.1.2. Evaluation

A TVKP system guarantees that the vehicle kilometre reduction goal and the corresponding emission reduction are always reached. Furthermore, avoiding the system by refueling across the border is difficult because of the implementation on a European scale. However, the disadvantages of TVKP are the following:

- The price of a tradable vehicle kilometre can rise considerably because of low price elasticity. Consequently, opportunity costs of car transport will increase and this can lead to public or social pressure to lower the cap;
- Distrust of the implementation of new concepts;
- Downstream monitoring problems;
- TVKP are an imperfect indicator of CO_2-emissions, even when cars are divided in several categories. Consequently, other instruments are more suited for climate policy.

In terms of control and enforcement, TVKP may be cumbersome in practice, especially because there is no one-to-one correspondence between individuals and vehicles (Verhoef, Nijkamp and Rietveld, 1997, p. 537). Furthermore, a potential disadvantage of TVKP is the difficulty of applying this in a spatially differentiated manner. For example, in a system of congestion kilometre permits, rights are distributed to drive on congested roads during peak hours. The amount of congestion rights is based on the capacity of the roads. For example, one vehicle kilometre permit enables a car to drive one kilometre outside the city and outside peak periods. More tradable permits are necessary for other time/place combinations. However, this can entail difficulties in administrating, monitoring and enforcement.

5.4.2. Tradable fuel permits

In this paragraph, the different design elements of a tradable fuel permit (TFP) to reduce CO_2 emissions of road transport by passenger cars are described. Many of the emissions of road transport are directly dependent on fuel consumption (CO_2 emissions directly) and insofar as they are not, they will in any case depend on mileage driven which is in turn related closely to fuel consumption. Furthermore, critical remarks when evaluating the system are made.

5.4.2.1. Design

Again we will use the framework of Harrison (1999, p. 24-25) for the design of the system.

Threshold Phase

The primary goal of the TFP program is to reduce CO_2 emissions caused by passenger car transport. The aim is to comply with the targets laid down in the Kyoto Protocol. This would mean that the TFP program must realize an 8% reduction of private road transport related CO_2 emissions by 2012[149].

[149] The introduction of a permit program for individuals would be a major step towards an increasing public awareness of the problems addressed in the Kyoto Protocol.

The system will have to be implemented on a European scale. This allows a sufficient number of market players which enhances market liquidity as well as the development of the internal market. Moreover, pollution by CO_2 emissions is a cross-border problem that, in accordance with the Kyoto Treaty, can only be solved on an international, if not, global level.

Under a cap-and-trade program, an upper limit of total emissions has to be fixed. Using 1990 figures on CO_2 emissions by passenger, the total amount of passenger car mileage is multiplied by the amount of CO_2 emissions per passenger vehicle, which leads to a total of 404 million tons of CO_2 (Commission of the European Communities, 2000). In order to achieve an 8 % reduction by 2012, private passenger cars in the EU are allowed to emit 372 million tons of CO_2. If the TFP system was to become operational in 2008, the cap would be equal to the total emissions of CO_2 by passenger cars in 2007 and gradually decrease to Kyoto levels. Allowances take the form of tradable fuel permits that hold the right to consume fuel.

Design Phase

The TFP's will be distributed at the beginning of each civil year. Their validity is limited to one year. The imposition of a time limitation is likely to make monitoring and enforcement by the regulatory authority more easy. Banking (i.e. the transfer of rights to the next year) and borrowing (i.e. the use of next year's permits) are not allowed to discourage speculative behavior. However, there are no geographical restrictions. TFP's can be used in the whole European Union.

To coordinate the system and set up the market, a European institution will be founded with three important responsibilities:

1. Distribution of TFP's among member states, which, in turn, distribute them among their citizens;
2. Determination of the annual cap for the EU and each member state; and
3. Supervision of the member states on the correct compliance with the TFP system.

Financial institutions or insurance companies can act as brokers between buyers and sellers. The usage of these established institutions that are well known by the general public is likely to minimize transaction costs.

As Rietveld, Nijkamp and Verhoef (1997) have pointed out, several groups of permit holders should be distinguished. To create sufficient political and social support, TFP's should preferably be distributed for free to three age categories: youngster (0 till 18 years), active citizens (19 till 65 years) and retired people (above 65 years). This is merely for reasons of fairness and legitimacy since, as stated by Montgomery (1972) following Coase, the initial distribution of permits will not affect the ultimate allocation.

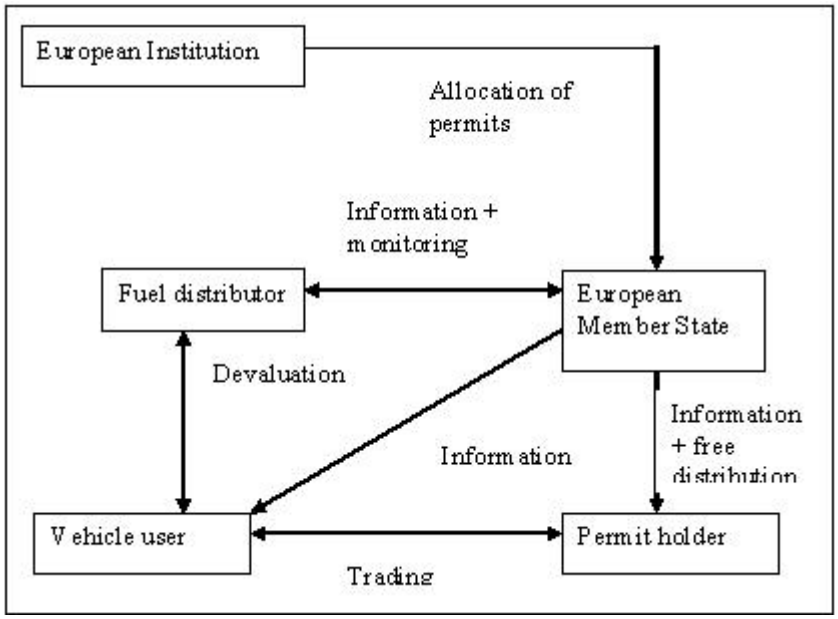
Implementation Phase

Five players are involved in this European scheme:

1. A European agency;
2. The EU-member states;
3. The permit holders;

4. The vehicle users; and
5. The fuel distributors.

Figure 6: Operation of TEP



The European agency has to distribute the rights among the Member States. They, in turn, have a duty to inform the permit holders, vehicle users and fuel producers before distributing the allowances among their citizens. The fuel rights are then traded between the permit holders and vehicle users. The fuel distributors have to devalue the permits when fuel is bought. The Member States also have to set up a system to monitor fuel distribution.

Basically, there are two ways to monitor a tradable rights program: upstream, where fuel producers are monitored, and downstream where monitoring is focused on the end-users of fuel (Haites and Mullins, 2001). There are significant differences between the two approaches with regard to the both the type and number of market players who need to be monitored. An upstream scheme will have far fewer and much bigger actors. In terms of organizational efficiency, an upstream monitoring system entails fewer players, hence less administrative costs. While downstream monitoring involves more players and may lead to higher administrative costs, it has to be pointed out that a more comprehensive plan may yield bigger social benefits. Nevertheless, monitoring in the TFP program should be done upstream. The fuel companies will have to hand the right amount of TFP's to the monitoring agency for the volume of fuel they have distributed.

Under the U.S. Acid Rain Program, enforcement comprises four stages (Tietenberg, 1985):

1. Detection of the violation,
2. Notification of the offender,
3. Negotiation about compliance measures, or
4. Sanctions for non-compliance.

This approach will be copied for the TFP permit program. As mentioned before, a European regulatory agency will monitor the member states. When they fail to comply (with this or any other requirement), the EU Treaty obliges the Union to take action and start an infringement procedure against the Member State. This procedure can be initiated by the European Commission or after an individual complaint. If no solution is reached, the case will be submitted to the European Court of Justice, which can rule to impose a penalty payment on the member state.

In general, tradable permit programs are prone to evasive behavior which is a major issue for enforcement. Although the system will be introduced on a European scale, there remains the problem of citizens crossing the Union's border to refuel. Levying an import tax on full gasoline tanks or obliging all outgoing transport to refuel may resolve that problem.

The TFP program can be implemented with technology that already exists and works today. The permits will be put on so-called smart cards that are fraud-resistant and allow easy and inexpensive transactions. When refueling at a gas station, the smart card discharges TFP at a terminal. It should be impossible to refuel without using this card, otherwise the program is ineffective. Recharging the card can be done at bank terminals or via the internet using an individual internet account number. The permit holders can sell their surplus fuel permits via financial institutions or the internet with as little regulatory interference as possible. Different market structures can be set up to facilitate the trade of TFP's:

1. Direct search markets (without intermediaries),
2. Brokered markets (with intermediaries but with market players still holding the rights),
3. Dealer markets (where intermediaries hold the rights), and
4. Auction markets (where an agency holds the rights).

Following Wrigley (1997), it is highly likely that an electronic market will emerge.

5.4.2.2. Evaluation and recommendations

Tradable fuel permits is a promising policy instrument. It reconciles (dynamic and static) efficiency and effectiveness concerns with social and ecological goals. Since a genuine market price is established, the TFP program induces benefits from the welfare maximization properties of the market system. Moreover, it provides clear incentives for technological innovation when cost reduction from innovation outweighs the price paid for TFP's. Since the cap is an upper limit on the externality to be restrained, the TFP program and alike will, by definition, always reach its goals. When the goal is an ecological one, placing a cap is the most effective way of curbing environmental pollution. Finally, the TFP program will lead to income redistribution from polluters to non-polluters. From a social perspective, this seems quite fair (polluters pay principle). It should be clear that the initial distribution of TFP's can be manipulated to promote certain income redistribution. This aspect, however, is likely to be highly controversial. There are, of course, some other issues remaining.

The Kyoto target of an 8 % reduction in CO_2 emissions is an objective that not necessarily has to be met by private vehicle transport. When higher emissions reduction rates are more likely (and less costly) in other areas (like central heating), then these opportunities should be explored and exploited first. This is not a criticism on the TFP system as such, but a warning that the efficiency rates of reduction programs in different areas should be carefully examined and compared. Tradable rights systems can be applied for various alternative schemes. However, since car related CO_2 emissions account for 12 % of the total emissions and a further growth is forecasted, it seems reasonable to target it. Moreover, the introduction of a permit program for individuals seems a major step in increasing public awareness for the problems raised and addressed in the Kyoto Protocol.

Actual policy measures to reduce CO_2 emissions can easily be fitted into a future TFP program. The TFP program is likely to lead to more technological innovation in the car industry and it is compatible with fuel taxes. When TFP's are distributed via auctioning, fuel taxes may even be cut back. Furthermore, the TFP program can be applied to other emission gases (CO, N_2O, HC, SO_2 and volatile organic compounds), transport modes and sources in other sectors. Public transport operators, for instance, can set the ticket price to include the TFP. Alternatively, passengers can use their TFP's and discharge their smart card when they buy a ticket and travel by public transport. The TFP program can also include to other household activities; Verhoef, Nijkamp and Rietveld (1997) describe a tradable CO_2 permit scheme for the Netherlands, which includes CO_2 emissions of inland shipping and railway use and those produced by the household energy consumption. Fleming (1997) proposed a similar tradable quota system to shift national economies away from their dependence on fossil fuels.

Since the TFP program does not require the development of any new technology, set-up costs will be relatively low as are enforcement costs when monitoring is done upstream. What remains difficult to estimate, are the costs of institutional (political and administrative) preparation.

The TFP program is very flexible in manners how to achieve the overall and individual objective.

1. The fuel industry may develop less polluting fuels;
2. Vehicle manufacturers can develop less polluting engines; and
3. Car users can change their transport behavior.

Since TFP's affect total CO_2 emissions, the possible effects of such a program can be classified in three categories:

1. Reduction in emissions per fuel unit,
2. Reduction of fuel consumption per passenger kilometer; and
3. Changes in the total amount of passenger kilometers.

Following Pargal and Heil (2000), it is expected that the TFP program will have an effect on fuel type and fuel efficiency, average age and size of the car fleet, number and length of trips, road congestion and road conditions, occupancy rate and modal choice. However, it is our belief that (with reference to table 9), for the regulation of congestion and localized

environmental externalities, both in particular relevant to urban areas, additional measures may be needed.

5.4.3. Tradable entry permits

Are tradable entry permits (TEP) a valuable alternative for road pricing? To answer this question, we will first design the system in a city centre. Secondly, the various possible (side)-effects of such a system are discussed. Finally, TEP are compared with tolling or road pricing systems, such as the congestion charging scheme in London.

5.4.3.1. Design

Using the methodology as developed by Harrison (1999), three main aspects in the organization of the permit program are distinguished, namely the threshold, design and implementation issues.

Threshold Phase

The basis purpose of a TEP system is to set an upper limit on cars/trucks exiting the ring-road and driving into the city centre. A tradable permit enables one car/truck to enter a city centre during a working day between 7 a.m. and 8 p.m. The price of the permit is determined at the time when the city centre is entered[150]. But it is fair to state that the cost-effective outcome will be achieved by the market because demand will be very high in peak periods which increase the price of a permit. No TEP are required for leaving the city centre. Because of fairly obvious reasons such as stimulating public transport and maintaining commercial activities in the city centre, the following groups are not included in the system:

- Public transport, namely regular services buses;
- Merchandise vehicles;
- Police vehicles;
- Fire brigade vehicles;
- Military vehicles; and
- Taxis and emergency services.

Trucks are included because by using TEP, they are stimulated not to enter the city centre during peak hours. The cap of the system is determined by the capacity of the approach roads.

Design Phase

All citizens of a certain city (starting from a certain age, for example 18) are assigned a number of free permits. The free distribution is applied primarily for reasons of fairness and legitimacy. In this way, one of the major sources of social opposition against road pricing, namely its redistributive impacts, could to a considerable extent be overcome (Verhoef, Nijkamp and Rietveld, 1997, p. 539). Moreover, the regulator now gives the scheme a progressive[151] element assuming that the use of the permits is more

[150] Table 9 has indicated that, for the regulation of congestion, one would actually have to use a system that allows for differentiation over time, space, and individual trip lengths.

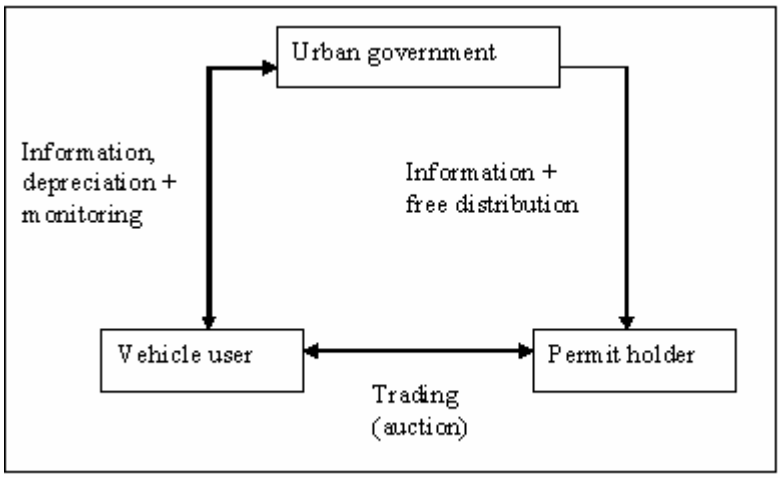
[151] The regressivity or progressivity of a tradable permit or tax can be explained to a great extent by the burden that is borne by the share of the population that is located in the poorer sections.

concentrated in the richer sections. Than, citizens not owning cars (and living in poorer sections) are rewarded by giving them smart cards which they can sell to car owners. An auction is set up for the non-residents and freight traffic. In the beginning of the calendar year, the permits are distributed for free by the local government offices. Those residents who use public transport or do not commute can sell their excess permits on the stock market to non-residents who want to enter the city.

Implementation Phase

Financial institutions or insurance companies can act as brokers between buyers and sellers. The usage of these established institutions which are well known by the general public is likely to minimize transaction costs.

Figure 7: Operation of TEP



Three actors are involved in our TEP system, namely the urban government, the permit holders and the vehicle users. The urban government distributes a number of permits among the residents. This local authority also informs the permit holders and the vehicle users. Then, permits are exchanged between the permit holders and vehicle users through an auction. Finally, the local authority depreciates the permits and monitors the car users at the entrance gates.

The TEP program can be implemented with technology that already exists and works today. The permits will be put on so-called smart cards that are fraud-resistant and allow easy and inexpensive transactions (Crals, Keppens and Vereeck, 2004). At the entrance gate, all vehicles are observed. The electronic beacons communicate with the on-board unit. By passing the entrance gate, the smart-card will be depreciated automatically, depending on the time entering the city centre. Such a system guarantees sufficient anonymity, as road users will not receive a fully specified overview of their trips at the end of the month (Verhoef, Nijkamp and Rietveld, 1997, p. 536). If the vehicle does not dispose of a working on-board unit or if the credit on the smart card is insufficient, an image of the number plate will be made. Using automatic number plate recognition (ANPR), this number plate will be identified and the vehicle owner is obliged to pay a fine. The monitoring and enforcement are therefore based on existing technologies which are

already operational. This technology comprises number plate recognition and CCTV (Closed Circuit TeleVision) camera observation at the entrance gates.

Finally, it is important to stress that the smart cards could in principle be valid for all (urban) areas in the country, with the rates charged being different over time and place, so that the market for trading is sufficiently large and transparent.

5.4.3.2. Evaluation

Using the framework of Bohm and Russell (1985), the following criteria will be used to assess the TEP system:

1. Information intensity. This first criterion attempts to measure the need for information which has to be available to the implementation agency. Under a TEP system, it needs to know how to set the cap. More specifically, it has to calculate the capacity of the access roads. Furthermore, it needs information about the citizens of the city centre in question, their age and addresses. Market players also have information needs about permit prices, number of permits and how to buy and sell permits. As already pointed out, financial institutions can act as brokers by providing information and search for potential trading partners. Information intensity is part of transaction costs which will be discussed in more detail in this chapter.
2. Ease of monitoring and enforcement. The monitoring is organized downstream, meaning at the level of the individual users and is analogous to monitoring systems of existing cordon pricing systems.
3. Flexibility in the face of change. A changing demand for permits due to economic growth or decay will be reflected in the permit price, which will act as an economic stabilizer. Another source of flexibility is the bureaucratic ability to reduce the total amount of permits. Due to limited time validity, the government can adjust the total amount of permits to present needs. In case of market distortions, it can buy back or sell additional permits.
4. Dynamic effects. The TEP system rewards sustainable travel behavior patterns of citizens and provides a continuing incentive for them to search for innovative approaches for further permit reductions, for instance carpooling or using public transport.
5. Distributional effects. Through the choice of the initial permit distribution method, a desired income redistribution or transfer among different groups can be achieved. However, this equity aspect arising from the initial permit allocation method is often one of the most controversial and politically sensitive areas in the design process as already pointed out. In our current design, the TEP system rewards sustainable travel behavior patterns of citizens.

5.4.3.3. TEP versus other road pricing systems

In this section we compare TEP with other road pricing systems, such as the London congestion charging scheme with regard to effectiveness, cost-effectiveness and technology.

Tradable permits are effective in the sense that the target is always realized: no more cars/trucks are allowed to enter the city centre during working days

then the capacity of the road allows. In other words, the cap ensures the effectiveness of the system (Koutstaal and Nentjes, 1995). A rise in demand for road use and therefore permits will drive up the price but the amount of TEP remains unchanged because the cap is fixed. In a system of tolling or cordon pricing, the amount of cars driving into the city is determined ex post. For example, in a growing economy demand for road use can rise and consequently congestion can increase. Ultimately, the amount of cars driving into the city may well exceed the optimum level due to a high price-inelasticity of the demand. Literature regarding elasticities of demand with respect to congestion charges is relatively rare. In Singapore, however, where charges are revised regularly, there has been considerable scope for evaluating effects of price changes. Dodgson et al. (2002) summarize various studies for Singapore suggesting point elasticities in the order of -0.12 to -0.35 with respect to congestion charges. More commonly calculated are elasticities of demand with respect to fuel prices. Goodwin (1992) calculated short-run and long-run elasticities of -0.16 and -0.32 respectively. These numbers are still considered standard values for the responsiveness of car travel demand with respect in fuel prices. The preliminary results suggest that the London Scheme has so far been successful in achieving the stated congestion reduction targets. Furthermore, traffic reduction has been higher than expected, which means that elasticities might have been underestimated prior to the implementation of the Scheme (Shaffer and Santos, 2003).

When examining alternatives types of transport policy instruments, a key question is whether particular instruments are likely to result in marginal abatement costs being equated across sources. Revesz and Stavins (2005) have shown in their analysis of the cost-effectiveness of taxation that each agent will carry out abatement up to the point where its marginal control costs are equal to the tax rate. A challenge with charging systems is identifying the appropriate tax rate. The government is not able to set this appropriate level without knowing the costs of control. In practice, governments become usually involved in a trial-and-error process. First, an arbitrary rate is chosen and the corresponding amount of reduction is observed. If this reduction is smaller than desired, the tax will be raised and vice versa.

In London, due to the rather crude nature of the area licensing scheme, the system lacks the ability to adequately charge differentiated prices both temporally and spatially. Ultimately, the Mayor settled upon a £5 charge, deciding that it provided adequate incentive to achieve significant congestion reduction, but with less public backlash likely to be associated with a higher charge (Shaffer and Santos, 2003). Compared to pre-charging conditions, the amount of all cars entering the central zone has decreased by 31% in 2003. This reduction in the number of cars has been partially offset by increases in incoming motorcycles, taxis and buses. Traffic levels (all vehicles) inside the central zone have decreased by 15%, which is close to the objectives which were stated before introducing the program (Shaffer and Santos, 2003).

TEP are cost-effective in sense that they allow citizens to choose for the least costly means of achieving the objective. Under a permit system, an

acceptable overall level of congestion is established and distributed or auctioned off among citizens in form of permits. Car users can choose between complying with existing permit specifications or by purchasing additional permits. The price of one entry permit is determined by the market, hence truly reflects the citizens' marginal willingness-to-pay. Those commuters who are able to reduce their usage of the approach roads relatively cheaply and easily will do so, rather than purchasing permits. They can, e.g., in the short run shift to public transport or combine their tradable permits with other commuters and carpool. However, in the long run, citizens can also relocate close to their work or close to a railway station. Of course, these possibilities are only valid provided that parking facilities and public transport are adequate to set off the increasing amount of users.

Finally, a TEP system relies on the same technology that is used in existing entrance zone systems such as in London and Rome. In London, the congestion charging scheme is based on camera-technology. The number plates of each vehicle, also the vehicles that are exempted or have already paid, are registered. In Rome, a combination of smart-card responder and camera-technology is used. For the TEP system, we have opted for the combination in Rome for the following reasons:

- Since a smart-card can easily be (re)moved, transactions (such as recharging) can be done relatively simple;
- Since only the number plates of non-compliers are registered, there is a significant reduction of the number of data that need to be redirected to the server which simplifies the processing, and;
- The sense that 'big brother' is watching is limited.

In conclusion, we can say that technology does not differ very much between TEP and road pricing systems. The only difference lies in the design of the system that is chosen and its specifications.

5.4.3.4. Conclusions

In this paragraph, a system of TEP is designed using the methodology developed by Harrison (1999). One tradable permit enables one car/truck to enter the city centre during 1 working day and applies for all private cars and trucks driving into a city centre between 7 a.m. and 8 p.m. The price of this permit is determined by the time that the city is entered. All citizens of the city centre are assigned a number of free permits. Furthermore, an auction is set up for non-residents and freight traffic. After evaluating the system, it was found that TEP offer citizens a lot of freedom in choosing how to meet the reduction goal. Furthermore, the system provides a lot of flexibility to policy makers because the cap can be adjusted over time. TEP also give an incentive for citizens to search for other, more sustainable means, of transportation, such as carpooling or using public transport.

Compared to other road pricing systems, tradable permits are more effective and cost-effective. The cap ensures the effectiveness of the system while the tradability guarantees the cost-effectiveness. Compared to existing cordon pricing systems, the same technology is used which proves that technology will not preclude the use of TEP.

5.4.4. Comparison of the different scenarios

In order to compare TVKP, TFP and TEP, the main design elements will be summarized in the following table:

Table 10: Main design elements of TVKP, TFP and TEP

	TVKP	TFP	TEP
Purpose / cap	Limit # vehicle kilometers – cap set on total # vehicle kilometers of reference year (1998) – only cars are included in the system	Reduce CO_2 emissions, cap based on CO_2 emission per passenger vehicle	Limit cars/trucks entering a city centre – cap based on capacity of the approach roads
Geographical area	European Union	European Union	City centre
Allocation method	Free distribution based on age categories	Free distribution based on age categories	Free to citizens – auction for other road users
Temporal flexibility	Banking and borrowing not allowed	Banking and borrowing not allowed	Banking and borrowing not allowed
Monitoring and enforcement	European and national institution – downstream monitoring	Upstream monitoring at level of fuel companies	Downstream – number plate recognition of non complying vehicles
Technology	Smart card and on-board unit	Smart cards and on-board unit	Smart cards and on-board unit / entrance gates

The main advantages and disadvantages of these three possible applications are summarized in table 11.

Table 11: Advantages and disadvantages of TVKP, TFP and TEP

Program	Major advantages	Major disadvantages or limitations
TVKP	Directly related to mileage	No incentive to avoid peaks or to change car technology
TFP	Relatively simple control and enforcement Controls both mobility and energy efficiency	Not suitable for controlling time-dependent and place-dependent externalities
TEP	Suitable for time-dependent and place-dependent externalities	May be perceived as complicated

Finally, we will discuss the relationship between the three scenarios and the marginal external cost. Under a tradable vehicle kilometre permit system, each individual receives a certain number of personal vehicle kilometres, which can be traded. The overall target, defined as total vehicle kilometres, has a close connection to the trip characteristic mileage. Furthermore, as shown in table 9, there is a relatively strong dependence between mileage and environmental externalities, noise, safety and congestion. The idea is that, as vehicle kilometres diminish, so will marginal external costs. This is the case of environmental externalities, but because the system is less easy to apply in a spatially differentiated manner, noise, safety and congestion are not really being dealt with.

Probably the most promising direction for the use of tradable permits in the regulation of road transport externalities, particularly in environmental externalities, is through as system of tradable fuel permits. This system creates simultaneous incentives to reduce car use and, in long run, to purchase energy-efficient, and often cleaner, vehicles. For the regulation of localized (noise) and congestion environmental externalities, tradable fuel permits are less suited.
Tradable entry permits are mostly directed to time and area of driving (congestion) but, insofar that external costs are, at the margin, higher in urban areas than elsewhere, there exists a relationship between tradable entry permits and noise, safety and general environmental externalities. These results are summarized in the following table.

Table 12: Relation between the three scenarios and the marginal external cost

Scenario (influence on trip characteristic)	Marginal external cost			
	Environmental externalities	Noise	Safety	Congestion
TVKP (mileage)	***	*	*	*
TFP (mileage and vehicle used)	***	***	**	**
TEP (time, area)	*	**	**	***

* relatively weak relation, ** moderate relation, *** relatively strong relation

Source: own analysis

Concluding, it seems that for the regulation of non-localized and time-independent external costs of road transport (often environmental externalities), tradable fuel permits offer the most attractive option,

providing simultaneous incentives to reduce mobility in the short run and to purchase environmentally friendly and energy efficient cars in the long run (Verhoef, Nijkamp and Rietveld, 1997, p. 545). Fort he regulation of time-dependent and localized externalities, often congestion and other externalities in urban areas, a supplementary system of tradable entry permits appears to be effective.

5.5. Transaction costs

Does road pricing entail fewer transaction costs than tradable transportation permits or are the costs of both systems prohibitively high which explains their limited use? In order to compare instruments that induce the same incentives, we will perform a transaction cost comparison for road pricing and tradable entry rights. Those two instruments have the same main objective, namely to reduce congestion and, to a lesser degree, noise, safety and environmental externalities[152]. The design and goal of tradable entry permits are already discussed in the previous section. Road pricing is a generic term for charging for the use of roads or a specific section of the road network using direct methods[153]. Examples include traditional methods using toll booths such as turnpikes and toll roads, as well as modern schemes employing electronic toll collection such as the London Congestion Charge, the Singapore Area Licensing Scheme[154] and the Trondheim Toll Scheme in Norway[155]. The aims of road pricing are several. The most obvious is financing: raising money to pay back the construction of the road or to build new facilities. A second aim is management, by varying charges by time of day (sometimes called congestion pricing or value pricing), users can be discouraged from making trips during the peak times and encouraged to travel in the off-peak, thus balancing flows and reducing congestion loss. A third aim is to discourage driving altogether, which is often supported by environmentalists. A fourth aim, more applicable to rural areas, is to directly charge for any public bad that arises from use of a road.

5.5.1. Determination of relevant transaction cost categories

The following cost categories will be compared in our transaction cost analysis:

---

[152] On the contrary, tradable fuel permits are best compared with carbon taxes because distributing fuel permits at an upstream level will reduce planning costs, but then the resulting price effect on car users and other fuel users would akin to a carbon tax.

[153] This is in contrast to indirect charges such as gas taxes, or other types of taxes.

[154] The Singapore Area Licensing Scheme, introduced in 1975, charged drivers entering downtown Singapore, and thereby aimed to manage vehicle traffic. It is one of an umber of anti-congestion policies that has operated in Singapore since the 1970s. In September 1998, the Area Licensing Scheme was terminated as Singapore switched to the current Electronic Road Pricing System.

[155] This system was initially introduced to fund the building for new ring roads so that the heaviest traffic would not have to pass through the city centre. The charge is 1.60 $ and lorries pay a rate double that of cars. More than twenty toll booths were built, closing off all approaches to the city. The drivers have to fit a little plastic device to the windscreen of the car which communicates with the toll booth when the car passes through, deducting money from the user's account. The Trondheim toll system is due to be removed in 2005, when the initial aim of building and improving the city's ring roads will have been completed and paid for.

– Legislative costs (fixed) which includes lobbying costs, public support costs and legal barriers costs;

– Information costs (fixed) about external costs;

– Search (planning) costs (fixed) for the appropriate design of the system;

– Operational costs (variable) including technology costs;

– Negotiation costs (fixed) between car users or between the government and car users;

– Contract costs (fixed) with other car users;

– Monitoring and enforcement costs (variable); and

– Compliance costs (variable).

5.5.2. Road pricing

Using price-based schemes in transportation is not costless. Therefore, we will first discuss all relevant transaction costs associated with road pricing.

5.5.2.1. Legislative costs

The relevance of the public support problem when considering road pricing policies is shown by the uneasiness it provokes within the community. Jones (1998) notes that, the reason why road pricing has never been widely implemented has been the public and political acceptability. According to him, the main public concerns about road pricing are:

– Drivers find it difficult to accept the idea that they are charged for congestion, which is something nobody wants, as opposed to paying for something they wish to acquire;

– Traffic congestion could also be relieved by improving public transport or using restraint measures such as pedestrianisation or restrictions to access in certain areas;

– Price inelasticity of the demand for car use will make the system ineffective;

– The technology used with road pricing will be unreliable;

– Electronic road pricing may violate the privacy of the driver;

– If the pricing system is a cordon, it will cause congestion around the cordon, thus shifting the problem to previously uncongested areas;

– Road pricing is a form of taxation and even if the revenues were earmarked, there would always be fear that the government may change the rules; and

– Road pricing is unfair because those least able to pay the charges will be excluded. Of particular relevance is the fact that many individuals do not perceive pricing to be an appropriate mechanism to eliminate excess demand (Oberholzer-Gee and Weck-Hannemann, 2002, p. 361). They also state that individuals much prefer the first-come first-served principle to pricing when private goods are scarce. Some variant of first-come first-served is of course how most road space is allocated today.

In order to assess the acceptability of road pricing, not only individuals but also interest groups need to be considered such as industries (motor, freight,

public transport, road building), user group (motorists, truckers, passengers, contractors), environmental groups (walking/cyclists, anti-pollution, rail travellers, conservationists), and residents (pedestrians, recreation, shoppers, home owners) (Santos, 2000). Wieland et al. (2004) classify the relevant actors and interest groups as follows:

- The transport providers and their interest groups (transport firms like railways, airlines, private infrastructure providers, but also lobbying groups like automobile clubs, user groups and the like);
- Politicians/regulators/bureaucrats (namely all individuals wielding political influence in the transport sector);
- The public and its different interest groups (all citizens who may have their opinion on a certain element of transportation policy); and
- The media.

These interest groups play an important role in the implementation process of road pricing because they are affected by the policy which, in turn, means that lobbying is likely to prevail. We will indicate now what their preferences are and how they will react to the introduction of road pricing.

Assuming that transport providers prefer that instrument which maximizes profits, it is likely to expect that those affected by road pricing are likely to campaign against it. However, those who benefit from the policy, for example public transport if expanded in order to meet the rising demand, are expected to lobby in favour of the policy, again inducing substantial lobbying costs. It is also expected that interest groups, with a perceived stake in the system, to oppose marginal cost based pricing policies, may be much more common than similar organisations acting for their support (Niskanen, 2003). It can be in the interest of workers of transport providers to continue existing policies they are used to. They either may not understand the new policies they should be responsible for or they may be afraid of likely organisational rearrangements and even for losing their jobs.

Road users are normally the group whose members are likely to lose out when road pricing is introduced. This is however an argument to target revenues from road pricing to projects that benefit drivers. It can be assumed that resistance will be lower when taxes are channelled back to the transportation sector. Earmarking revenues for the purpose of maintaining and improving the road infrastructure apparently convinces some drivers that the increase in taxes is in their best interest (Oberholzer-Gee and Weck-Hannemann, 2002, p. 365).

Marcucci and Marini (2003) have analyzed the interrelation between voting and the political support. They state that the decisions concerning the adoption of road pricing measures are taken by politicians that operate under a re-election constraint and have perfect foresight on the aggregate voting intentions of their constituency. Such politicians will, therefore, promote only those policies that would pass an election test. However, there can be policies supported by the majority ex post that could fail a voting test ex ante as well as policies that are supported ex ante but would not be voted for ex post. The failure in adopting potentially Pareto-improving policies by the politicians could be explained, for instance, via the different organizational

ability of lobbies, pressure groups, policy time inconsistency, spatial inconsistency and politicians' credibility. However, perhaps the most important reason to be optimistic about the prospect of road pricing systems is that fact that many voters regard environmental issues as fairly important (Oberholzer-Gee and Weck-Hannemann, 2002, p. 359). However, in contrast to the general support for environmental programs, citizens appear to be less concerned with road congestion per se. Without a doubt, congested roads are seen as a major issue. But Oberholzer-Gee and Weck-Hannemann (2002, p. 361) indicate that air pollution is considered worse than traffic congestion. Therefore, to make road pricing schemes politically more acceptable, the environmental impacts need to be emphasized on. By focusing exclusively on road congestion per se, economists forgo the support of environmental groups which often see themselves as anti-automobile.

Bureaucrats will try to expand their budget. Because road pricing is likely to expand their budgets, lobbying costs tend to be substantial. Moreover, they will try to minimize efforts to acquire information and thus invite interest groups to submit information via hearings. Consequently, a decisive role is played by scientists and consultants due to the complexities inherent in transportation policy. These scientists are interested in higher research funds and thus will promote an active transportation policy of the government (Michaelowa, 1998).

A word on the influence of the media may also be in order here. The primary objective of private mass media is to earn money. Transportation issues are able to raise emotions and in these very cases the media can become very influential. For example, the most important cause of the failure of introducing road pricing in the Netherlands was a campaign ("Stop Rekeningrijden") that was started by the Dutch Automobile Association and was strongly supported by the media, which started a whole supportive campaign by itself (Wieland et al., 2004).

In general, without any additional measures, public support for road pricing will be relatively low. However, several measures can be taken in order to make road pricing more acceptable (Marcucci and Marini, 2003):

1. Make sure the objective of the scheme meets the main public concerns. The cost-based level of price reflects the intensity of demand and the revealed preference of travellers for certain times and locations. A high price draws attention and mobilizes resources to popular routes for investments. Therefore, road pricing can serve as a guide in the planning of investment and the improvement of services (for example public transport providers);
2. Demonstrate that there are no effective alternative solutions;
3. Earmark the revenues and provide alternatives;
4. Keep the scheme as simple as possible. The system should be simple to understand and convenient for motorists to use. Extremely complex and continuous pricing gradations should best be avoided because of 'bounded rationality[156]' on the part of drivers' cognitive limitations.

[156] The property of an agent that behaves in a manner that is nearly optimal with respect to its goals as its resources will allow.

For safety reasons, driver's attention ought not to be diverted for more than a very short time period in the process of using the system;

5. Consider carefully all technological issues. The road pricing should be able to operate reliably under all conditions and should charge users correctly; and
6. Address equity issues. It is necessary that the toll-tax incidence of the road pricing system is publicly perceived as fair for it to be acceptable. This is related to the use of the revenues, where a truly revenue neutral system, where all the revenues from road pricing are directly or indirectly returned to the population of users, is assumed to be fair.

From a psychological perspective, road pricing acceptability is strictly intertwined with the following issues: (1) problem perception; (2) mobility related social norms; (3) importance of the aims to be reached by the measures; (4) perceived effectiveness and efficiency of the policy[157]; (5) equity; (6) revenue allocation; (7) attribution of responsibility and (8) information and awareness[158]. This also shows that, as stated before, revenue allocation is an important aspect of the public support costs. Following Santos (2000), revenues could be split in three parts and allocated equally to the following categories: (1) reduction in existing taxes or increase in social expenditure, (2) construction of new roads, improvement of existing ones or improvement in the standards of maintenance of the road infrastructure, and (3) improvement in public transport services[159]. The categories of expenditure to which the revenues would be allocated are: (a) monetary reimbursement to trip makers, (b) replacement of general taxes presently used to fund transportation services and (c) new transportation services. In principle, the most rational approach, economically speaking, is not to treat these revenues differently than other forms of governmental income, and to choose their most effective destination based on the preferences of the democratically elected government. However, revenues are often earmarked and used to subsidize improvements in the behaviour of specific target groups, usually the ones that paid the tax in the first place. When this is done, several negative characteristics, which are observed in subsidies, may arise (Bressers and Huitema, 2000, p. 73-74). For instance, many subsidies are aimed at the introduction of so-called 'end-of-pipe' techniques, where pollution is not prevented but only cleaned up afterwards. These techniques are often not the most cost-effective ones. In summary, the way in which revenues from road pricing is spent is often not aimed at an optimum contribution to the policy target or to the general good of society, but rather at making the extra charges acceptable by reducing (re)allocation effects as much as possible, regardless of the overall economic rationality of the process.

[157] In order to enhance economic efficiency, the road pricing system should be able to charge directly - as closely as possible - the external costs arising out of road use.

[158] The system should inform the motorists of the prices to be charged ahead of time and place, so that the trip decision can be rationally made and rerouted if necessary.

[159] However, it should be noted that the European Union is now working on a directive on the use and calculation of tolls. It is suggested that the toll revenues can only be used for infrastructural costs (Standaard, 2005). If such a directive would be decided on, using revenues for the improvement of public transport services is no longer possible in the European Union.

Legislation itself can also impose clear constraints on transport related policymaking. In particular, urban transport policies may to a great extent be directed to promote more general (rather than transport specific) goals: fiscal policies, economic vitality of a city, competition between communities to attract business and taxpayers, social and equity related goals, etc (Niskanen, 2003). Therefore, whilst there is a lack of laws that would facilitate or support the implementation of road pricing, at the same time there are important laws in many countries that can hamper or even prevent direct charges for road use. Such laws may be related to fiscal taxation, or they may be concerned with certain basic national constitutional rights or guarantees, such as freedom of access or movement, privacy needs and civil liberties. These laws can conflict with the need for road pricing, especially in case of different prices according to types of users (vehicles), space and time. Laws related to fiscal taxation may explicitly state that road pricing or taxes must not vary over time. And civil liberties legislation can constrain those forms of road pricing that need tracking of the location of individual vehicles. However, as stated by Niskanen (2003), most legal and institutional barriers could potentially be removed at national level if only sufficient socio-political acceptability (i.e. political will) existed.

In conclusion, this analysis clearly shows that legislative costs of road pricing, in particular lobbying costs, public support costs and legal barriers costs (which are dependent on the public and political support), can be substantial.

5.5.2.2. Information costs

In order to internalize external effects, the road charge on the individual user should be related to the marginal costs imposed on the rest of society – highest in congested conditions, lower in uncongested conditions but still calculated to cover pollution, noise, accident and road repair costs. As stated by Nash (2000), transport users are both suppliers of essential inputs and, obviously, consumers of the output. The optimal price will, therefore, differ from the usual definition of social marginal cost, the derivative of the total social cost (*TSC*) with respect to output, or traffic volume (*Q*). The total social cost is the sum of producer costs, user costs and costs external to the transport sector:

$$TSC = TC_{Prod} + TC_{User} + TC_{Ext} \qquad (3)$$

where TC_{Prod}, TC_{User} and TC_{Ext} are functions of Q.

Maintenance costs are also a part of a transport system's total cost. However, very few research studies take maintenance cost properly into account in a road congestion pricing scheme (Chu and Tsai, 2004). In reality, maintenance costs depend on a road's traffic condition, which is composed of various classes of vehicles traveling on the road. For example, in the case of transport infrastructure services, the definition of price-relevant marginal cost is the following:

$$MC = MC_{Prod} + Q\,\frac{\partial ACuser}{\partial C} + MC_{ext} \qquad (4)$$

The reason that this definition differs from marginal social cost is because part of user cost already born by the individual user making the decision is not relevant to the price that should be charged; only user costs imposed on others should be included in the price. Consequently, to calculate an efficient road charge, information on user costs and total marginal costs is needed.

Setting efficient prices therefore requires:

- An understanding of the physical relationships between traffic, congestion and environmental costs;
- An ability to value, in monetary terms, changes in congestion and emissions of pollutants when traffic changes; and
- A technically and economically feasible pricing regime to charge for the congestion and environmental costs.

Congestion and environmental costs are highly variable across space and time. Even in highly congested conditions, the network as a whole is used as only a small fraction of its rated capacity. For several hours per day, the entire network is essentially uncongested. Efficient use of road space therefore requires a highly differentiated tariff which will induce substantial information costs. More specifically, congestion costs must be quantified before road pricing can be implemented. The social costs of congestion can be measured by the deadweight loss and calculated from the difference between the marginal social costs and the price actually paid by trip makers. In general, the charges should be paid by all road users, including trucks and buses, at levels reflecting as accurately as possible the relative costs imposed by different kinds of vehicles.

From this, it can be concluded that information costs related to optimal road pricing, i.e. internalizing all external costs, are high.

5.5.2.3. Search (planning) costs

A flat fee for road use does not provide the right incentive which properly represents the social costs of road use. Congestion costs are only one of the externalities associated with urban traffic. There are also the diverse environmental costs of noise, atmospheric pollution, community severance, and so on (Button, 1995, p. 41). In many cases, these externalities are positively correlated with congestion, e.g. noise and emissions rise with frequent deceleration and accelerations and traffic on congested roads travel at speeds well below the most efficient for their engines. The conclusion which is often drawn, therefore, is that road pricing would contain some of these adverse third party environmental effects even it did not optimize them. In some cases, however, this application leads to excessive temporal and spatial spreading of traffic. Road pricing could equally result in more environmental damage at times (especially early mornings and evenings) and in places (for instance, in residential areas) where only limited nuisance exists currently. Consequently, linking the road charge to the external effects is necessary in order for the road pricing scheme to be optimal. From a scientific point of view, it becomes more and more evident that an external effect of a human activity interacts with its environment in a manifold way and that the interaction is a very complex system (Rudel, 2003). Therefore,

the relationship between a cause and its effect can be a very complicated function, with thresholds, feed-back relations, time lags and so on. This clearly shows the difficulty of establishing a relationship between a cause such as air pollution and health problems and of identifying the cause in order to apply the polluter pays principle. The difficulties to establish scientifically the exact relationship between cause and effect are also reflected in any attempt to monetize the external effect. For the valuation, a broad range of techniques have been developed over the last decades. Examples are (Verhoef, 1996, p. 23-24):

• Behavioral approaches such as
  – Hedonic techniques: an example of hedonic techniques is the property value approach which infers willingness-to-pay for a non-market effect from observed behavior (revealed preferences) in property markets. It is thus relevant only when the studied non-market effect influences property values;
  – Travel cost methods: this method is a revealed preference method which values preferences indicated by actual behavior in a surrogate market. Specifically, an individual spends time and resources when traveling to and from a particular resource site. The travel cost method might be applied when individuals voluntarily visit a site to use recreational resources, to collect resources or to deposit wastes. The method employs regression analysis to estimate the relationship between visitation rates and travel costs incurred to and from the site[160];
  – Production factor method: this method is based on the fact that many natural resources, processes and qualities are used as production factors. Improvement of environmental quality may lead to a reduction of production costs for the sector making use of the relevant quality. This method tries to value natural qualities by valuing their impacts on production costs;
  – Contingent valuation methods: with this method, individuals are asked via a survey to imagine that a market exists for a particular resource, good or service, and, contingent upon this hypothetical market, to state their valuation of the associated benefits and costs[161].
• Non-behavioral approaches such as:
  – Damage costs;
  – Costs of illness; and
  – Prevention costs which consider only investments that have already been realized to internalize external costs[162].

From a theoretical point of view, behavioral techniques deserve preference, as they aim at assessing the individuals' valuation of the effect. However, costs are much higher when undertaking valuation studies.

It can thus be concluded that search costs, as information costs, are higher when the external costs are fully internalized. Road pricing based on congestion costs entails fewer information and search costs compared to a

[160] For a more detailed description, see Fuguitt and Wilcox, 1999.
[161] Ibidem.
[162] E.g. investments in noise protection as an approximation for people's willingness to pay to reduce noise avoidance.

full road pricing system based on all relevant external costs. Consequently, a trade-off exists between search costs on the one hand, and the optimality of the road pricing instrument on the other. Furthermore, search and planning costs are even higher when behavioral techniques are used to valuate the various external effects.

5.5.2.4. Set-up costs

It has become customary to use the term road pricing for a set of policy instruments that intend to charge vehicles the marginal external costs they are causing at the time when and at the location where travel occurs. However, depending on the pricing technology several types of road pricing systems can be distinguished (De Borger, Peirson and Vickerman, 2001, p. 41-43):

- Area licensing (vignettes): Under this system, a license is required to drive in certain areas and, in some cases, at certain times of the day. This is a rather simple scheme which insufficiently differentiates with respect to congestion conditions which limits the efficiency of the instrument;
- Cordon pricing: The idea is to define a cordon and to charge all vehicles upon entering that area. To be efficient, the fee charged should be differentiated according to travel conditions. If toll collection is not done electronically, an inconvenience is that the system itself causes some congestion. Electronic collection overcomes this problem;
- Automatic vehicle identification (AVI) is the first of two systems of electronic road pricing. With AVI, automatic means are used to check on and register entrants to an area where charges are levied. Information about the car is registered at the time of passing by certain checking points (gantries)[163]. This requires charges which are billed to the user at regular intervals. These charges can be varied according to the degree of congestion; and
- Electronic road pricing with smart cards: Smart cards help to solve the privacy problem for the user of the smart card. Registration and billing is done via the card, and no identification of vehicles is necessary. Of course, there is still a need for a back-up vehicle identification system to identify illegal users of a tolled road, but this can hardly be considered as a threat to individual privacy.

Traditional ways of collecting tolls (e.g. tollbooths in France) have high set-up costs and can impose long waiting periods on drivers. But with the advent of electronic tolling and other technologies, there are no significant technical barriers to more direct and efficient charges for road use. For example, in-vehicle meters, which record the travel characteristics of the vehicle can be used for congestion-based, time-based or distance-based charging (Santos, 2000). They do not require any roadside equipment but they have to be connected to the odometer[164] of the vehicle from which

[163] These checking points need to be permanently constructed in sufficient numbers to fully cordon off a route or area within road pricing is to be applied. These gantries must also be tied together with a dedicated communication system and all that data must be collected in an operations system.

[164] An odometer is an instrument provided in an automotive vehicle to indicate the total number of miles that have been travelled. The odometer, as the speedometer, is driven by a

average speed, time and distance can be obtained. There are also other systems which enable automatic vehicle identification for the purpose of charging for congestion to the proper driver. In London, for example, the congestion charging scheme is based on camera-technology. The number plates of each vehicle, also the vehicles that are exempted or have already paid, are registered. In Rome, a combination of smart-card responder and camera-technology is used.
In theory, potentially the biggest cost involved in setting-up a charging scheme would be the cost of establishing a vehicle fleet with the necessary equipment on-board. In general, the set-up costs vary with the type of technology and with the size of the scheme in question. However, due to the latest developments, technology is no longer a barrier for the introduction of road pricing (Santos, 2000). As these sorts of applications become more widespread, it may gradually become a standard item in new cars which reduces set-up costs.

Finally, a road charging scheme also needs to be set-up administrable. The key issues involved here are the costs of telecommunication between on-board units and back-office and the costs of setting-up the back-office processing operation. If the road pricing can be levied and collected by an established agency, set-up costs are of course smaller than in the case that a whole new back-office needs to be set up.

5.5.2.5. Operational costs

The operating costs of road pricing scheme can be substantial, depending on used technology. Registering drivers for any scheme, processing records of vehicle movements into charges, and issuing these charges as bills to drivers requires a significant back-office operation and, in case of a large number of vehicles, significant costs. The major driver of these operational costs seems to be labor. In addition, operating costs will rise with the complexity of the road charging scheme. However, in case of synergies with existing vehicle and driver services, additional costs of road charging schemes could be reduced considerably if these synergies are exploited properly.

5.5.2.6. Negotiation costs

As road pricing refers to charging for the direct use of the road, car drivers will be directly affected by the scheme. Because the system is compulsory, individual users are affected and the price is determined by the internalization of external effects, it is assumed that no negotiation between the regulating authority and road users takes place. However, road users can negotiate among themselves in order to minimize their costs. For example, car users can decide to carpool when commuting in order to limit payments. Negotiation costs will then incur between affected parties. Nevertheless, negotiation costs are assumed to be relatively small.

5.5.2.7. Contract costs

The costs of contracting are zero because of a spot transaction without time lapse between buying the road charge and the actual use of the road.

---

cable that the two share. When the vehicle is in motion, this cable moves a series of gears in the odometer, turning a set of numbered drums that count the miles travelled.

5.5.2.8. Monitoring and enforcement costs

Intuitively, it seems plausible that agents would have less of an incentive to evade low-cost regulation, and, therefore, that incentive-based instruments would be less costly to enforce. However, the conditions for minimizing enforcement costs turn out to be different from the conditions for minimizing abatement costs; consequently, an allocation of control responsibility among firms which minimizes enforcement costs will not necessarily minimize abatement costs (Krutilla, 2002, p. 259).

Any charging scheme will need a system of enforcement to deal with non-compliance behaviour by road users. This is, dependent on the nature of the system, likely to take on of three forms:

- Failure to pay by users who are already registered with the charging authority;
- Attempt by road users to provide fraudulent information about their identity or entitlement to exemption; and
- Driving in a charging area without having made arrangements to pay.

In general, enforcement against the non-payer or the person who seeks to defraud the system will involve a range of processes designed to identify the offender, to demonstrate that an offence has taken place and to apply the appropriate sanction. Enforcement will therefore need to reflect some key principles. First of all, enforcement must provide an effective sanction against evasion, ensuring that the public is aware that it is likely to become caught and face significant penalties as a result. Secondly, penalties should be proportionate and consistent with those of other infringements, while providing effective sanction against persistent evaders. Thirdly, enforcement should be simple and cost-effective, without imposing disproportionate additional burdens on police and courts. Finally, privacy issues[165] should be taken into account. Road charging potentially involves privacy problems because data collected can be used for billing purposes, thus linking information on vehicle movements with individual citizens (Secretary of State for Transport, United Kingdom, 2004).

The greater the complexity of any road charging scheme, the greater the specificity of data that need to be gathered about road use and the greater the enforcement costs. Furthermore, the greater the extent to which enforcement is pursued, the lower the marginal returns. In most circumstances, enforcement authorities will be faced with decisions about how far to pursue cases where there is little prospect of recovering the cost of enforcement, although to do so will increase the deterrent effect. Consequently, there is a trade-off between evasion rates, enforcement costs and the likelihood of detection. Technology also plays an important role in enforcement. If cameras are used to detect vehicles which are evading the charge, enforcement costs will be high because of the high number of cameras needed which, in turn, are also expensive to operate. However, if

[165] Privacy issues fall into two types: those relating to personal autonomy (the right of individuals to go about their daily lives without intrusive surveillance from public authorities) and those connected to information privacy (the right of individuals to have some control over the way information about them is used).

electronic vehicle identification (EVI) is used which involves setting a device in vehicles, enforcement costs could be significantly reduced.

5.5.2.9. Compliance costs

Road users incur costs to comply with the road pricing scheme. In order to minimize these costs, any road pricing scheme will need to reflect the following strategies:

- Ease of use: charge payers must have easy access to the means of registration and payment;
- Ease of understanding: charge payers must know exactly what is expected of them;
- Customer service; and
- Social inclusion: to be achieved through ensuring the widest range of methods of payment.

The primary source of compliance costs for road users involves taxpayers' loss of time, namely the amount of time that road users are delayed by paying charges. Costs will increase if road users have to pay at toll booths. However, electronic payments will minimize compliance costs. Consequently, like the previous cost category, compliance costs decrease on account of applied technology which uses electronic payment methods. In general, more precise rules might reduce ambiguity, easing compliance costs and might close avenues for complicated avoidance schemes (Kaplow, 1996, p. 138).

5.5.2.10. Conclusion

Two main conclusions can be drawn from this analysis. First, the nature and level of transaction costs associated with implementing road pricing vary with the type of system being used. More specifically, transaction costs are conditional upon the physical relationship between the road charge and the external costs. The more accurate the charge, in terms of internalization of all external effects, the higher transaction costs, more specifically information, search and planning costs.

Secondly, technology plays an important role in transaction costs of road pricing. While road pricing with electronic vehicle identification entails relatively high set-up costs per vehicle (setting a device in each vehicle), operational, monitoring, enforcement and compliance costs will be reduced. However, if is relied on camera technology, set-up costs per vehicle will be much lower while here, set-up costs of the gantries, operation, monitoring, enforcement and compliance costs will increase. In conclusion, transaction costs depend on the design of the system and the used technology.

5.5.3. Tradable entry permits

One of the major challenges in designing permit systems is how best to reduce implementation and transaction costs. Transaction costs can occur for several reasons and as a result of which, the optimization problem of a participant who wants to trade in permits will change. As stated by Stavins (1995), the effect of transaction costs is 'unambiguously to decrease the volume of permit trading regardless of the specific forms that the marginal

control cost functions and transaction costs function take'. Furthermore, the great number of users in the transport sector constitutes an obvious obstacle to introduce tradable permit systems, since negotiation costs are assumed to appear, a priori, prohibitive. We shall examine this question by discussing all relevant transaction costs associated with tradable entry rights.

5.5.3.1. Legislative costs

In case of tradable entry rights, it can be assumed that different lobbies will build up a considerable resistance against this regime, since it is against tradition to limit the right to free access to road infrastructure and the free choice of transport means. The automobile plays a fundamental role in mobility, as there is frequently no transport alternative. Therefore, tradable permits can make an explicit restriction on freedom of movement which is a fundamental right that is universally recognised in declarations of human rights (cf. United Nations) (Raux, 2002, p. 148). However, more and more actors are now looking very closely at tradable permits as an interesting approach to reduce the problems of road congestion. For example, the idea of using tradable permits on the Alpine corridors[166] might be a promising start in the European transport policy to clearly set quantitative goals and incentives to more sustainable transport system (Rudel, 2003).

If a regulatory authority is to negotiate successfully with market participants who are often organised in professional groupings with means of exerting considerable political pressure, that authority will have to have effective powers, backed by a strong political commitment. When low-cost adaptation is possible, there is less need for strong political will. For example, when introducing the gasoline lead reduction program in the U.S.[167], there were affordable technological solutions available for replacing lead, and the consumption of leaded gasoline was already on a downward track because of renewal of the automobile fleet (Raux, 2002, p. 179). On the opposite, the commitment of the politicians will have to be stronger if the range of low-cost adaptation possibilities is limited. At the moment, there is no proof of large political will when it comes to reducing greenhouse gas emissions, or, at least, that whatever will exists, may be insufficient in light of the scope of the changes required. However, there is no doubt that public opinion is becoming increasingly aware of the gravity of the situation. Yet because of the complexity of the system and the social costs of imposing abrupt lifestyle changes are deemed unacceptable, the required policy decisions have been delayed (Raux, 2002, p. 179). From a policymaker's perspective, there is no guarantee that a tradable permit system can be past by the legislature. Indeed, the more stringent the proposal, the less chance it will pass. Since even the attempt to pass new legislation is costly, policymakers may decide that it is simply not

[166] The Alpeniniative launched the idea of introducing a kind of exchange market for tradable permits giving the right to cross the Alps in Switzerland or even on the whole Alpine bow. This idea has been taken up by the federal administration and is now being investigated in a research project of the Swiss association of transportation engineers.

[167] The objective of this program was to eliminate use of lead as a gasoline additive in the United States. This system of granting refineries rights to add lead to gasoline was part of a family of permits based on the concept of averaging. The program was in place form 1979 to 1996.

worthwhile to spend the political resources necessary to push a tradable permits proposal against industry resistance.

The transport industry, as the polluting industry, has rent-maximizing incentives to prefer quotas over taxes. The argument of the number of industry jobs is often taken by workers who want to keep their jobs. Furthermore, the tighter the cap, the more resistance and lobbying can be expected from the industry. Regulated entities will oppose to absolute or severe norms because these can limit their growth. They prefer a system of relative or soft norms. However, relative norms have the danger that national goals are exceeded when regulated entities are growing. When choosing absolute norms, participants will prefer that the rights are grandfathered because auctioning off the permits will bring along additional costs. With grandfathering of permits, a tradable permit scheme creates an asset of value to firms[168]. So, even if a firm now has to buy permits to cover all its use, it still can acquire the value of those additional permits by selling them in the future if its actual use is lower than what is allowed. This in turn creates an incentive for individuals to comply with their caps. Furthermore, road users can save considerable expenditures with grandfathered permits, since the individual user has to pay only for additional permits, if needed. Taken as a group, permit holders who receive permits for free only have to make additional expenditure for reducing car use. Consequently, resistance of industry against the use of economic instruments to control road use can be overcome more easily in a system of tradable permits with grandfathering than auctioned permits (Nentjes and Dijkstra, 1994).

Organized pressure groups, buoyed up by strong public sensitivity to air pollution, congestion, noise or employment, can weigh heavily on public debate over a tradable permits program. For example, trade unions are mostly interested in the preservation of employment. Since an auction of permits may yield additional funds for transport improvement and makes the car user really pay for its use, some pressure groups rationally prefer this distribution mechanism. Environmental movements are generally opposed to the principle of giving 'a right to pollute'. They prefer a system that forbids pollution rather than allowing it. They also morally object to setting a price on environment.

Bureaucrats have clear budget-maximizing behaviour and if politicians would choose for the implementation of tradable transportation permits, their preference lies with an auction system.

The legal specification needs constitute to an important part of legislative transaction costs. The tradable right and the cap need to be defined legally and this should be related to a (just) initial distribution of the rights for

[168] The permits acquire a monetary value which, in case of grandfathering, achieves importance for individuals not only because they serve as a legal justification of the individual's behavior but (assuming a decline in the individual's use) they also serve as (potentially quite valuable) trading goods. Furthermore, if the initial allocation takes place on the basis of actual use in a given year, rather than on the basis of an equally strict standard for all actors, free allocation also means that individuals which already did their best in the past to reduce use as much as possible are disadvantaged, compared to individuals which so far have invested little in sustainable transport (Bressers and Huitema, 2000, p. 74) .

individual actors to make trade possible. Furthermore, although grandfathering is financially more attractive and acceptable to firms than auctioning, it is unclear whether grandfathering is also acceptable to governments because it could constitute state aid under EC law if it is seen as a distortion of fair competition. For a successful implementation of trade in rights, some fundamental legal questions need a clear answer and barriers need to be removed.

In conclusion, this analysis shows that political and public support is on the rise but much depends on the design of the system. However, legislation needs to be adapted to this evolution, which means that legislative costs remain relatively high.

5.5.3.2. Information costs

In a system of tradable permits, no information is needed about price elasticity's or abatement costs. The regulating authority only needs to set the height of the cap. These costs are dependent on the choice of the tradable permit system. In a system of TEP, the level to look for is the capacity of the roads. Furthermore, data are needed about citizens for distributing the permits but this information is available at the governmental agency[169]. After establishing the cap, prices will adapt automatically to changing circumstances. This cap will often be politically determined which can become a laborious and time-consuming exercise. The objective of this cap is to set a reasonable pressure for adjustment, not a disruptive force that could invite a countervailing reaction.

The initial distribution of the permits leads to different information costs. While with free distribution no information is needed about past or future use of the private car, grandfathering will entail much more information costs. As with emission permits, the initial distribution method does not affect the efficacy of the instrument and therefore, compared to road pricing, information costs are negligible.

5.5.3.3. Search (planning) costs

The most important planning issues that will be discussed are: geographical area, choice of permit allocation and temporal flexibility.

The first aspect is whether a system of tradable transportation rights is confined by boundaries of a certain territory. If is chosen to implement the system on a European scale, it should be decided how the permits are distributed among the different Member States. A clear distinction should be made between the tasks at central EU level and those delegated to Member States. Permits can be grandfathered and sold at the E.U. level or they can be allotted to the Member States who in turn distribute them. With regard to this last option, it should be realised that Member States would not be allowed to use their permits to support specific sectors or firms by grandfathering permits in excess of those allowed by the rules of grandfathering. If, for the execution of various tasks, a national bureau as well as a European institution need to be set up, planning costs are higher.

[169] In comparison, information is required about the desired amount of CO_2 emissions when introducing tradable fuel permits.

The tasks of a national bureau consist of, among others, the registration of the ownership of the permits, grandfathering of permits to designated actors and monitoring and enforcement. A large scale is well-suited for cross-border problems and ensures market liquidity. The potential for trade not only depends on the number of actors but also on the supply and demand for permits and this, in turn, depends on differences in abatement costs.

Secondly, permits can be allocated to different target groups. Allocating permits to individuals is attractive primarily because it would provide a direct incentive to reduce fuel consumption or vehicle use not only through choice of vehicle, patterns of travel behaviour (including mode choice) and residential location, but also through driving behaviour such as reduced acceleration. But there are also some disadvantages which are frequently used to criticize the allocation of permits to individual users of transport. The most significant disadvantage would be the substantial planning costs incurred if individuals participate in the tradable permit market. These planning costs are, for example, a centralized electronic system that is needed to handle a large number of transactions and a large scale public education campaign. Furthermore, if permits in the transport sector are grandfathered (issued free, approximately on the basis of past usage of fuel or km travelled), special arrangements would need to be made for migrants, new car owners and tourists. Allocating of permits to fuel wholesalers, or producers, offer another alternative but this is not applicable to tradable entry rights. Here, planning costs would be lower[170]. The two different ways of distributing can also be combined, meaning that rights can be distributed to individuals, but monitored at the level of fuel wholesalers or producers.

Imposing time limits on the use of tradable permits offers a convenient administrative mechanism for planning and controlling use on an annual basis. Tradable permits issued at the beginning of the year would simply expire at the end of that year, and new ones would be issued for the next period. Governments would be aware in advance of the maximum annual level, assuming no cheating. However, time limits could generate large movements in prices at various times of the year (Dobes, 1999, p. 89). We assume that, if permits are valuable assets, they will tend to be used reasonably soon (unless there is an expectation of appreciation in real value), or be sold. Otherwise, the holder would incur an opportunity cost similar to holding cash at home rather than in an interest-bearing deposit.

As with emission rights, it is fair to conclude that search costs are largely dependent on the design of the system. In general, low cost alternatives do not impair its efficacy. However, in case of tradable entry permits, search costs will be high because permits are allocated to individuals.

[170] However, the effect of rationing fuel through the quotas established by a tradable permit system is passed on to all vehicle operators in the form of higher prices, which gives the impression to individuals that more taxes are levied (Dobes, 1999, p. 87-88).

5.5.3.4. Set-up costs

To coordinate the system and set up the market, an urban (or national or European[171]) institution will need to be founded or used to perform several tasks. This institution will be responsible for the distribution of the permits, the determination of the cap and the supervision. As with emission permits, the extent of the set-up costs is dependent on the distribution system chosen. Tradable entry permits make use of auctioning and free distribution which induces high set-up costs. Data will have to be collected for determining the quota which individuals will receive when permits are grandfathered. These costs however only have to be incurred once. The costs of setting up the yearly auction are higher. These responsibilities belong to the urban authority.

Organization set-up costs are also dependent on the technology used. Permits can be put on so-called smart cards which are installed in the vehicle and used in conjunction with an in-lane camera/reader to communicate identifying information about the vehicle, customer, and account balance information of the non-complier. Some portions of the smart card information are fixed, such as vehicle and customer data, while others are updateable, such as permit credit balance, which changes each time permits are reloaded and the smart card is used.

5.5.3.5. Operational costs

As with emission rights, few requirements, approval processes and well defined entry rights are necessary to keep operational costs minimal. Approval procedures for trades between individuals imply that individuals willing to trade have to make costs before trading. This reduces their potential cost savings. Less trade takes place than would be possible (Bressers and Huitema, 2000, p. 75). Trading may be further limited if one adds further constraints such as limited information. This means that traders select their partners randomly (Koutstaal, 2002, p. 270). Bureaucratic interference therefore should be kept as low as possible because this can obstruct the system and entail substantial operational costs. Citizens need the freedom to decide themselves who to trade with and how to comply with the cap.

In conclusion, analogous to emission rights, permit holders should be able to sell their excess permits with as little regulatory interference as possible in order to keep operational costs low.

5.5.3.6. Negotiation costs

Negotiation costs occur because of bargaining between citizens or between the government and individuals. However, as with emission rights, institutions and different market structures can be set up to facilitate the trade of permits such as direct search markets, brokered markets, dealer markets and auction markets. If an electronic market emerges, negotiation costs will be further reduced.

[171] The need for a European institution is only necessary when introducing tradable fuel permits. Tradable entry permits are mostly implemented on an urban scale, which reduces the need for an institution because most tasks can be performed by the urban authority.

Once a party has found another party to trade, bargaining will start. When information on prices is publicly available, this bargaining process will be standardized and entail few transaction costs. When citizens are confronted with substantial search costs, fewer transactions will occur and hence the functioning of the market will be undermined. Ultimately, negotiation costs will be minimized by a transparent market, the use of market intermediaries, minimal complexity of government regulation and clarity of property rights.

5.5.3.7. Contract costs

As with emission rights, the costs of contracting are zero since the purchase of a permit is merely a spot transaction and no time between the promise and actual transfer of the entry right exists.

5.5.3.8. Monitoring and enforcement costs

Adequate monitoring and enforcement is vital to the success of any tradable permit scheme. In principle, the transport sector would not be likely to differ significantly from other sectors of the economy in requiring monitoring and enforcement to prevent cheating. There are, however, significant differences in the cost and difficulty of these tasks, depending on how the permit scheme operates. Placing permit liability upstream would be efficient, provided that the resulting permit market is competitive. Downstream monitoring, as in the case of tradable entry permits, involves more market players and thus higher costs. Whether permits are monitored at individual level, at fuel producers/wholesalers or importers level, governments need to have reliable measures of usage to make sure that there is no consumption without permits.

Enforcement comprises four stages: detection of the violation, notification of the offender, negotiation about compliance measures and sanctions for non-compliance. In case of TEP, the violation will be detected when passing the entry gate through number plate scanning. The offenders will be notified and if no negotiation about compliance is possible, they will have to pay a fine. This fine has to be high such that the expected costs of fraud[172] exceed the costs of sticking to the rules. Also, the environment or congestion level should not suffer from fraud. Therefore, in addition to a fine, actors who have failed to comply should be forced to acquire permits to cover there external costs (Koutstaal, 1996, p. 26).

Furthermore, transaction costs depend on the fact if a tradable transportation system can fit in with existing institutions for levying taxes. These administrations exist in most western countries, meaning that monitoring and enforcement costs can be kept relatively low.

5.5.3.9. Compliance costs

The costs of compliance are comparable to those of road pricing because the same technology is used. This technology, namely smart card and electronic payments, guarantees a high level of compliance and will make a system of tradable entry rights just as feasible as road pricing as far as compliance is concerned.

[172] The expected costs of fraud equal the chance that fraud is discoverd times the level of the sanctions.

5.5.3.10. Conclusions

The following conclusions can be drawn from the transaction costs analysis of tradable entry permits. First of all, the amount of transaction costs is largely dependent on the design of the system. In general, a tradable permit system implemented on a small scale by a national authority that distributes permits for free, not based on previous use and without approval processes, with the use of smart-cards, electronic markets and monitored upstream will induce fewer transaction costs than a large European scale, where permits are auctioned off and monitored downstream.

Secondly, there exists a trade-off between some cost categories. While a downstream allocation induces high planning costs, monitoring costs can be kept relatively low when using smart-cards for all vehicle users. It is therefore fair to conclude that technology plays an important role in the development of tradable transportation permits and thanks to recent development, transaction costs do not prohibit the use of tradable permits in the transport sector if smartly designed.

5.5.4. Transaction cost comparison

Only by assessing the total transaction costs, it is possible to choose one mechanism over the other, or a combination of both. Given that an effective mechanism should be implemented, our transaction cost analysis will answer the question which policy, road pricing or tradable entry permits, entails the least transaction costs.

5.5.4.1. Information and search costs

There are significant differences between information and search costs of road pricing versus tradable entry rights. For setting efficient prices in road pricing, the physical relationship between traffic, congestion and environmental costs needs to be established and these external costs need to be valued. Furthermore, a differential road charge needs to be levied based on time and place. Concluding, transaction costs are clearly a function of the amount of information that is to be transmitted, and the timing of these transfers. A trade-off between the degree of differentiation in the pricing scheme and the amount of information that is required to be collected and transmitted exists and the scale of this trade-off will depend upon the minimal amount of information that is needed to accurately infer the characteristics of individual journeys. With tradable entry permits, only the cap needs to be established and no further information is necessary on price elasticity's and abatement costs.

5.5.4.2. Monitoring, enforcement and compliance cost

The monitoring, enforcement and compliance costs are dependent on the technology used and the following time and energy that the individuals need to comply with the system and the government needs to effectively monitor and enforce the system. Because road pricing and tradable entry permits use the same technology, these costs are comparable for both market-based approaches.

5.5.4.3. Negotiating and contracting cost

Road pricing entails no contract costs and very low negotiating costs because the system is obligatory, and no negotiation between governments and citizens is possible. Tradable entry rights induce also minimal contract costs because a spot transaction takes place. However, negotiation costs depend on the market mechanism chosen. Auction or electronic markets will substantially lower these costs because prices are then publicly available which reduces the bargaining process.

5.5.4.4. Administrative costs

Set-up costs of road pricing and tradable entry permits are comparable because again, the same technology is used for both systems. In both cases, a new institution can be created or the function can be fulfilled by existing (transport) tax administrations.

5.5.4.5. Legislative costs

These costs are not a good decision criterion to reject or choose one approach because in both cases, lobbying for or con the program will take place.

5.5.4.6. Conclusion

All the previous results are summarized in table below. From this table, the first conclusion that can be made is that tradable entry permits can induce high transaction costs, but so does road pricing. Much depends on the design of the system and the technology used. Developments in new technology will ensure that transaction costs associated with implementing a road pricing or tradable entry permit system will be at a lower level. Information costs are a decisive factor in choosing between both instruments. While no information is needed about price elasticities and marginal abatement costs in case of tradable permits, road pricing is only efficient if there is sufficient differentiation in the road charge to induce the appropriate incentives.

Table 13: Comparative transaction costs of market-based transport policy instruments

Transaction costs	F*/V°	Road Pricing	Tradable Entry Permits
Information costs	F	**Very high** (physical relationship between traffic, congestion and environmental costs, ability to value external costs)	**Very Low** (cap, free distribution, auctioning) **Low** (cap, grandfathering)
Search (planning) costs	F	**Very high** (differential road charge) **Low** (flat fee)	**High** (allocating permits to individuals) **Low** (allocating permits to firms)
Negotiation costs	F	**Very low** (no negotiation between government and road users, minimal between road users)	**High** (direct search market) **Low** (brokered or dealer market) **Very low** (auction, electronic market)
Contract costs	F	**Zero** (spot transaction)	**Zero** (spot transaction)
Set-up costs	F	**Very high** (tollbooths, new back-office) **Average** (automatic vehicle identification and in-vehicle meters, existing tax administration)	**High** (new institution) **Low** (smart cards)
Monitoring and enforcement costs	V	**High** (camera technology, differential prices) **Average** (electronic vehicle identification)	**Average** (downstream, electronic vehicle identification) **Low** (upstream)
Lobbying costs	F	**High** (public transport pro, other transport industry con) **Low** (vulnerable road users groups)	**High** (free distribution: interest groups, transport industry) **High** (auctioning: environmental groups, bureaucrats
Public support costs	F	**High** (treasury) **Average** (earmarking revenues) **Low** (providing alternatives and addressing equity issues)	**High** (auction) **Low** (free distribution because of freedom of movement)

Operational costs	V	**High** (personnel)	**Low** (few requirements and no approval processes)
Compliance costs	V	**High** (toll booths) **Low** (electronic payments)	**Low** (technology)

* = fixed; ° = variable

5.5.5. Policy implications

Comparison between tradable permits and equivalent taxes are normally based on standard analysis that assumes absence of transaction costs. As Stavins (1995) shows, the existence of transaction costs introduces ambiguities into the choice between permits and other policy instruments, 'the supposed symmetry of taxes and permits becomes questionable, and the need to compare these instruments on a case-by-case basis becomes more compelling'. Unfortunately, there is no a priori method of choosing between taxes and tradable permits. In case of road pricing, a flat fee will induce far fewer transaction costs that differentiated prices, but will also not be very effective. Therefore, in the following table, a comparative transaction cost analysis is performed of *effective* road pricing and tradable entry permits measures (inducing the appropriate price incentives).

Table 14: Transaction costs of effective market-based transport policy instruments

Transaction costs	F*/V°	Road Pricing	Tradable Entry Permits
Information costs	F	**Very high** (internalization external costs, variable road charge)	**Very low** (cap, free distribution, auctioning)
Search (planning) costs	F	**Very high** (differential road charge)	**High** (allocating permits to individuals)
Negotiation costs	F	**Very low** (no negotiation)	**Very low** (auction, electronic market)
Contract costs	F	**Zero** (spot transaction)	**Zero** (spot transaction)
Set-up costs	F	**Average** (automatic vehicle identification)	**Low** (smart cards)
Monitoring and enforcement costs	V	**Average** (electronic vehicle identification)	**Average** (downstream, technology electronic vehicle identification)
Lobbying costs	F	**High** (public transport pro, other transport industries con) **Low** (vulnerable road users groups)	**High** (free distribution, auctioning)
Public support costs	F	**Low** (providing alternatives and addressing equity issues)	**Low** (free distribution)
Operational costs	V	**High** (personnel)	**Low** (few requirements and no approval processes)
Compliance costs	V	**Low** (electronic payments)	**Low** (technology)
Total costs		**High fixed** costs of effective road pricing, **average** variable costs	**Average fixed** costs, **low variable** costs

* = fixed, ° = variable

Table 14 reveals that, from a transaction cost perspective, the effective tradable entry permit system is downstream operation in which the urban authority distributes the permits (on a smart card) for free and ensures that excess permits can be sold via an electronic market. Table 14 also shows that effective road pricing entails higher fixed costs, namely information, search and set-up costs, than an effective tradable entry permit system.

6. Tradable fiscal deficit rights versus regulation (Stability Pact)[173]

6.1. Introduction

The Delors report (1989) argued that monetary union without fiscal convergence might lead to monetary and economic instability. Therefore, it recommended binding fiscal rules limiting the size and financing of fiscal deficits. Subsequently, the debate on excessive deficits, the need for binding fiscal rules in the EC, and the coordination of fiscal policies has been wide-ranging (Buiter, Corsetti and Roubini, 1993, p. 60). The European Union followed the Delors Report in adopting principles for fiscal discipline of EMU Members, the so-called Stability and Growth Pact. The provisions of this Treaty have proven to be highly controversial. Many economists have attacked the Treaty's convergence criteria provisions, which limit the size of budget deficits to 3 % of GDP and debt-to-GDP ratios to 60 %, as being arbitrary and likely to impose substantial costs in terms of unemployment and lost economic output due to forced fiscal stringency at inappropriate times (Willett, 2000). In this chapter, we will elaborate further on the weaknesses of the current Stability Pact.

With monetary union removing the option of countercyclical monetary policy at the national level, one can argue that greater flexibility in fiscal policy is needed. There is a strong parallel between this fiscal problem and the market for pollution permits. In a market for pollution permits (as discussed in chapter 4), the regulatory authority sets the overall pollution limit and pollution sources sell their permits if their cost of pollution reduction is below the permit's price or, otherwise, buy additional permits. A system of tradable deficit permits among European countries, as proposed by Casella (1999), would allocate deficits where their value is highest, making it possible to implement the desired fiscal discipline at minimum total cost. Given the general idea of a system of tradable permits, the exact design can vary. For example, countries with different debt positions can be treated differently, mirroring the fear that deficits from economies with larger outstanding debts may be particularly destabilizing for the Union as a whole. We will reflect upon this design and consider both micro- and macro-economic aspects.

Although permit trading is thought to be more effective and efficient, it is also thought that it induces higher transaction costs than command-and-control policy. Using a comparative transaction costs analysis, we will

[173] Part of this chapter has been published as: Crals and Vereeck (2003b).

demonstrate that the transaction cost advantage of regulation over permit trading is not as straightforward as economic theory suggests.

This chapter is organized as follows. The first section defines the concept of tradable deficit rights and discusses the micro-economic aspects of introducing such a system. Then, the macro-economic aspects of tradable deficit permits are analyzed and the business cycles, the character of the budget deficit, national debt and the demographic situation are taken into account. The following section discusses the difficulty of Germany to comply with the Pact and proposes to implement a national system of tradable deficit permits between the federal government and the Länder. In the final section, the transaction costs of both policy instruments, namely the current Stability Pact and tradable deficit rights are analyzed and compared.

6.2. Micro-economic aspects

The Stabilization Pact (Treaty of Amsterdam) wanted to create a stable monetary order in Europe[174]. It did so by imposing strict fiscal and monetary targets upon the Member States. A worldwide economic recession[175] hitting the Old Continent is forcing the largest economy, Germany[176], to relax the 3 % national deficit rule. The purpose of this requirement was to constrain crowding out effects. National governments borrowing on a unified euro-market would put upward pressure on interest rates thus harming citizens of other Member States with balanced budgets. Relaxing the EMU requirements under German pressure is, however, sending the wrong signals to financial markets and has the potential of destroying the Union's monetary credibility. This paragraph examines the possibility of trading deficit rights among countries. Under this system, the option to borrow on the euro-market could be sold to countries that are in a temporary need of

[174] The EU Treaty Article 105.1 states that the primary objective of the European Central Bank shall be to maintain price stability. The four principal reasons for placing primacy on price stability are: (1) price stability improves the transparency of the relative price mechanism, thereby avoiding distortions and helping to ensure that the market will allocate real resources efficiently across use and time, (2) stable prices minimize the inflation risk premium in long-term interest rates, thereby lowering long-term rates and helping to stimulate investment and growth, (3) if the future price level is uncertain, real resources are diverted to hedging against inflation or deflation, rather than being put to productive use; and (4) maintaining price stability avoids the large and arbitrary redistribution of wealth and incomes that arises in inflationary as well as deflationary environments, and therefore helps to maintain social cohesion and stability.

[175] After achieving 4 % growth in 2000, the global economy began to slow in 2001, when the real GDP growth rate fell to less than 1-2 % for the first time since 1994 due to the economic downturn in major economies such as the U.S., Germany, Japan and Singapore. The conditions began to improve in Europe starting from the second half of 2002.

[176] In Germany, the deterioration of business and consumer sentiment grew more pronounced and real GDP growth in 2001 was only 0.7 %.

additional deficit spending. This system allows more fiscal flexibility without loosing monetary credibility since the total borrowing capacity of the Member States remains equal.

6.2.1. The Stability Pact

The Stability and Growth Pact consists of three components: the "European Council Resolution on the Stability and Growth Pact", the "Council Regulation on the Strengthening of the Surveillance of Budgetary Positions and the Surveillance and Coordination of Economic Policies" and the "Council Regulation on Speeding Up and Clarifying the Implementation of the Excessive Deficit Procedure". The Resolution commits all parties: the Member States, the Commission and the Council to implement the EC Treaty[177] and the Stability and Growth Pact in a strict and timely manner. The Council Regulations themselves, unlike the Resolution, have legal force. The first Council Regulation refers to the strengthening of budgetary positions and the surveillance and coordination of economic policies. It commits those Member States which join the single currency, to submit a stability program to the Commission. The latter Council Regulation is based on article 104 of the EC Treaty and includes the specification of possible penalties and the voting procedure in case of excessive deficit (Irlenbusch and Sutter, 2003). According to the Stability Pact, an 'excessive' deficit exists if the annual deficit exceeds 3 % of a country's GDP. If so, warnings will be issued and, eventually, penalties levied. According to article 104c (2a) of the Treaty, a government deficit above 3 % of GDP is not excessive if that excess is "exceptional and temporary and the government deficit to GDP remains close to the reference value". While the Regulation on excessive deficits clarifies the concepts of "exceptional" and "temporary", it is silent on the notion of "close to the reference value". The definition of the term "exceptional" comprises two parts, firstly, unusual events which are not under control of Member States and which have major impacts on public finance[178] and, secondly, events of an economic nature[179] (Blyumental, 2004). The excess over the reference value shall be considered "temporary" if budgetary forecasts provided by the Commission indicate that the deficit will fall below the reference value following the end of the unusual event or the severe economic downturn. A general exemption from the excessive deficit procedure is provided, if a country faces a decline in the real GDP of at least 2 % at an annual basis. If growth rates are positive or if the decline in the GDP is less than a critical value (which has been fixed at 0,75 %), the Council will declare the deficit to be excessive and will start with the excessive deficit procedure.

---

[177] Treaty establishing the European Community (signed in Rome on 25 March 1957). Provisions concerning Economic and Monetary Union have been added to the EC Treaty by the Treaty on European Union (signed in Maastricht on 7 February 1992).

[178] These include natural disasters.

[179] Like severe economic downturn.

When no exemptions can be evoked, the Member State has eight months to take the necessary measures to reduce its excessive deficit. After those months, in case of non-compliance, sanctions will be levied. The first sanction is a non-interest deposit that the Member State has to put down until the excessive deficit is corrected. This deposit consists of a fixed amount (0,2 % of the GDP) and a variable amount (0,1 % of the GDP for each point excessive of the 3 % budgetary deficit). The cap is set on 0,5 % of the GDP. When, after two years, the situation has not been corrected, this deposit becomes a fine. In reality, this penalty has never been carried out. The political process is designed in such a way that it puts maximum pressure on a Member State not to exceed the maximum budgetary deficit.

There are several weaknesses in the Stability Pact which are widely discussed in the literature[180]. First of all, it forces governments to tighten fiscal policy exactly when growth is weak and thus limits or even prevents the functioning of automatic fiscal stabilisers. Countries need an instrument to deal with a temporary economic crisis. The Stability Pact takes away this possibility and leaves no room for differences between countries[181]. This implies that the ability of many governments to use fiscal policy during the cyclical downturns will be much reduced (Lossani, Natale and Tirelli, 2002).

Secondly, the sanctions are not automatic, but can only materialise after a long process of negotiations among EMU members. This arbitrariness in the application of the penalties creates uncertainty and could lead to difficult negotiations with individual countries. Consequently, it may undermine the Pact's credibility.

Finally, the different voting weights in the EU-Council of Ministers are an advantage for larger countries. They have more power to stop the excessive deficit procedure, giving them more room for manoeuvre in their fiscal policy than smaller countries. Currently, if an EMU-Member State has a deficit above 3 % of GDP, the European Commission has to prepare a report, making a recommendation to the Council for a decision. The Economic and Financial Committee (ECOFIN) also has to give an opinion on the Commission's report. When making a decision on whether an excessive deficit exists, the Council acts by qualified majority (which represents a minimum of 232 votes). All EU-countries, including the

[180] For example by Beetsma and Uhlig (1999).

[181] Before the EMU, governments often inflated their currency to reduce the level of public debt as a percentage of nominal national GDP. However, within the EMU, this option is effectively closed by transferring all monetary policy to the ECB. But still governments could increase public debt and thereby forcing the ECB to increase interest rates. Such a tight monetary policy would have adverse effects on other members of the EMU. Therefore, the Stability and Growth Pact restrict governments in their fiscal policy.

country under examination (and even EMU-outsiders), are allowed to vote in this decision.

The current distribution of voting power in the Council of Ministers is shown in the following table. Also the voting powers of the new Member States, which are currently not (yet) part of the EMU, are shown (in italic).

Table 15: Distribution of voting power in the Council of Ministers

Member State	**Votes**		
France	29	Sweden	10
Germany	29	Denmark	7
Italy	29	Finland	7
United Kingdom	29	Ireland	7
Poland	*27*	*Slovakia*	*7*
Spain	27	*Lithuania*	*7*
The Netherlands	13	Luxemburg	4
Greece	12	*Estonia*	*4*
Belgium	12	*Latvia*	*4*
Portugal	12	*Slovenia*	*4*
Czech Republic	*12*	*Cyprus*	*4*
Hungary	*12*	*Malta*	*3*
Austria	10	**TOTAL EU**	*321*

Source: Treaty of Nice, European Commission

Irlenbusch and Sutter (2003) demonstrate in an experimental setting that large players are, in fact, more successful in blocking their own punishment procedure. Currently, the five biggest Member States' population-wise in the 15-strong European Union have 60 % of votes. Because it are the large countries which are breaching the Stability Pact (see further), it can be assumed that they have more power to stop their own excessive deficit procedure or avoid sanctions.

Buiter (2003) states that fiscal rules in a monetary union should (1) be simple; (2) ensure the solvency of the state; (3) avoid pro-cyclical behaviour of the fiscal policy instruments; (4) make sense in the long run; (5) allow for important differences in economic structure and initial conditions; (6) aggregate into behaviour that makes sense at the level of the union as a whole; (7) be credible and (8) be enforced impartially and consistently. We add the condition that fiscal rules should induce low transaction costs. After analysing the current legislation, Buiter (2003) states that the rules of the Stability and Growth Pact satisfy unambiguously only the first two of the eight requirements. It could be argued to satisfy the third, avoiding pro-cyclical behaviour, as a country can take steps to have a public sector surplus that is large enough in normal times to eliminate the risk of hitting the deficit ceiling in unfavourable times. Whether the Stability Pact induces low transaction costs will be thoroughly examined in the fifth paragraph.

6.2.2. Tradable deficit rights

A rethinking of the fiscal-financial framework for the EMU is necessary and urgent. Muscatelli, Natale and Tirelli (2003) suggested allowing Member States within the EMU to exceed the reference ceiling stated by the Stability and Growth Pact, but only under certain conditions. For instance, countries willing to exceed the announced deficits targets should obtain the approval of the other Member States as well as the European Central Bank. Such approval should be accompanied by a country's plan for future fiscal reform in order to attain the deficit discipline enforced through the Stability and Growth Pact. Additionally, the remaining Euro countries must agree to implement policies such that union-wide deficit does not exceed the 3% deficit limit. However, this seems to induce high negotiations and delay costs because other countries have to agree to the exception. Another approach, proposed by Casella (1999), introduces the principle of tradable deficit permits. The deficit is an external effect that weighs heavily on the Euro-market and affects all members of the European Union. A high deficit in Germany affects the other members of the EMU in a negative way by putting upward pressure on the interest rate in the Eurozone. Crowding out has thus become a transnational phenomenon in the EMU. Deficits can be seen as negative externalities created by one Member State and spilling over to all others. To deal with the problem, the European Union chose a set of strict norms and standards to which countries have to apply. If not, fines are imposed. This is a clear example of a traditional 'command-and-control' policy. For many decades, economists advocate a 'market-based' approach for the internalization of externalities. Market-based instruments have several advantages compared to the command-and-control policy. They give flexibility at agents because they allow freedom of choice and create an incentive to search for an efficient way of reaching the goals. They are also more cost-effective than the conventional policies.

Learning from the tradable emission right systems, the following section will design a similar system of tradable deficit rights (TDR)[182]. Emission rights systems have three key features as a method of pollution control. Firstly, they provide the economy an upper bound on emissions. Secondly, since the permits can be traded, pollution abatement will be done at the lowest possible cost to the economy. Firms who can reduce emissions cheaply will end up doing the abatement: they will be able to make a profit by cutting their emissions and selling their extra permits. Firms who find it very expensive to reduce emission will buy permits instead. Thirdly, permits will ensure that the marginal cost of reducing emissions, is the same in all countries that participate in the scheme (McKibben, 1998).

[182] Along with the creation of a market for tradable deficit permits, Casella (1999) also advocates a system of sanctions for those countries which hold fewer permits than deficit units at the closing of the market.

The design of any permit trading system is complex, particularly because of the problem of the initial allocation of rights. To develop a system that works and limits transaction costs, several conditions need to be fulfilled like e.g. a good administration and monitoring & enforcement mechanism. Each element of the tradable permit system can improve or worsen the operational efficiency and smooth implementation of the system. The design of a TDR system will be discussed in the following paragraph.

6.2.3. Design of TDR

According to the Stability Pact an 'excessive deficit' exists if the annual deficit exceeds 3 % of a country's GDP. Not all countries are able to keep their deficit below this norm. In the following table, the general government surplus of each EMU Member State is given as percentage to the GDP.

Table 16: General Government Surplus in 2003

Member State	Surplus (% of GDP)
Finland	2,3
Luxemburg	0,8
Belgium	0,4
Spain	0,4
Ireland	0,1
Austria	-1,1
Italy	-2,4
Portugal	-2,8
The Netherlands	*-3,2*
Germany	*-3,8*
France	*-4,1*
Greece	*-4,6*
Eurozone	-2,7

Source: Eurostat 2005

This table shows that Germany, France, Greece and The Netherlands were not meeting the requirements of the Stability Pact in 2003[183]. Table 17 shows that at least six Member States could breach the 3% reference value for the fiscal deficit to GDP ratio in 2004[184].

Table 17: Growths and deficits 2002-2004

	GDP%			Deficit/GDP		
	2002	2003	2004	2002	2003	2004
France	1.3	0.2	1.7	3.2	4.1	3.7
Germany	0.2	-0.1	1.5	3.5	3.8	3.6
Italy	0.4	0.3	1.2	2.4	2.4	3.2

[183] In June 2005, the European Commission agreed that Italy should enter the excessive deficit procedure as agreed in the Stability and Growth Pact. According to the latest figures of Eurostat, Italy had a deficit of a least 3.1 % in 2003 and 2004. The projected deficits for 2005 and 2006 are set to exceed 3.1 %. Furthermore, for 2003 and 2004, the debt-to-GDP ratio remained at around 106-107 %, well above the 60 % reference value in the Stability and Growth Pact.

[184] More recent information is currently unavailable.

Portugal	0.4	-1.3	0.8	2.7	2.8	3.4
The Netherlands	0.2	-0.8	1.0	1.9	3.2	3.5
Greece	3.9	4.2	4.0	1.4	4.6	3.2

Source: Verde (2004, p.15)

The President of the European Commission, Romano Prodi, suggested that these requirements may be loosened or postponed (Collignon, 2004). This statement will certainly undermine the credibility of the European monetary policy and the Euro. Financial markets are in need of predictability and tranquillity to prosper. The introduction of tradable deficit permits might bring a solution to the need for additional deficit spending while maintaining the trust of the Stability Pact. The parallel with tradable emission permits is obvious. The Stability Pact puts uniform quantitative limits on the budgetary deficit of each Member State. Meeting this constraint comes with different costs for each Member State, depending on the country's debt structure and stage in the business cycle. A system of tradable deficit permits will allocate deficits where their value is highest and reach the overall cap at minimum cost. Accordingly, with TDR, individual Member States can exceed the budgetary deficit norm of 3 % but, at the end of the year, the total budgetary deficit in the whole Eurozone will meet the 3 % norm. This guarantee brings the stability that the new monetary union that the Euro-market needs.

6.2.3.1. Determination of the cap

In a TDR system, each country receives a number of deficit permits equal to 3 % of its GDP[185]. One deficit permit gives the right to a deficit of 100 million Euros. These permits are freely tradable. At the end of the year, each country has to present enough permits to cover the year's deficit.

Table 18: GDP at current market prices 2003 (in billion €) and TDR

Member State	GDP 2003 at current market prices (in billion €)	3 % of GDP (in billion €)	TDR (1 permit = 100 million €)
Austria	226,1	6,783	68
Belgium	269,5	8,085	81
Finland	143,3	4,299	43
France	1557,2	46,716	467
Germany	2128,2	63,846	639
Greece	153,5	4,605	46
Ireland	134,8	4,044	40
Italy	1300,9	39,027	390

[185] GDP estimations are not always correct and during the year, events can occur which can alter significantly the GDP projections. Therefore, permits could be distributed for free based on an updating scheme. For example, Member States receive permits equal to 3 % of the GDP of the year before.

Luxemburg	24,0	0,72	7
The Netherlands	454,3	13,629	136
Portugal	130,5	3,915	39
Spain	744,8	22,344	224
Eurozone	**7267,1**	**218,013**	**2180**

Source: European Commission, European Economy, Statistical Annex.

This table shows that there would be 2180 permits of 100 million € in circulation in the Eurozone. For example, Germany, which has a deficit of 3,8 % of the GDP[186], would initially need 809 permits[187] to allow it to run this deficit. In the TDR system, it initially only has received 639 permits. As a consequence, Germany has to buy 170 extra permits from other countries that have excess permits.

6.2.3.2. Allocation aspects

Because every Member State is allowed to run a 3 % deficit each year, it is entitled to these deficit rights for free. At the beginning of each calendar year, the TDR will be distributed. Member States that do not use their entire annual rights, can sell them partly or entirely at the current market price to other countries that need more. Ongoing regulated auctions will allow the Member States to buy or sell permits according to their expectations of current and future needs.

Countries that are facing a deficit larger than 3 % will have to buy extra TDR. This means an extra cost for the Member State. But this is also the case in the Stability Pact because those countries, who do not meet the 3 % limit, face a steep fine. The important difference lies in the determination of the amount they have the pay in case of non-compliance with the Stability Pact. A TDR has a market price while the fine is arbitrarily determined.

6.2.3.3. Inter-temporal trading

It will not be allowed to bank permits. This means that Member States cannot transfer TDR to the next year. Banking could have as a consequence that the tradability after some time would show a cyclical pattern. Furthermore, banking can interfere with the liquidity of the permits at the end of a year because Member States can bank their permits for the following years. An option would be to allow banking during a business cycle. During a business cycle, an economy grows, reaches a peak, and then begins a downturn followed by a period of negative growth that ends in a trough before the next upturn. In this option, TDR can be banked for the next year in the same business cycle. However, today business cycles are widely known to be irregular, varying in frequency, magnitude and duration.

[186] A deficit of 3,8 % of the GDP equals 80,872 milliard €.
[187] One permit = 100 million €.

This irregularity will cause uncertainty which will hamper the trading of permits.

Borrowing permits is not allowed. It could create an enormous deficit because Member States will keep on borrowing from the following year and will not make the necessary adjustments to limit their budgetary deficit.

6.2.3.4. Market power

Market power occurs when there is not enough potential competition. In this scheme, there are only 12 countries of very different size. Hahn (1984) showed that the presence of a monopsonist in the permits market distorts the equilibrium price and leads to higher compliance costs than in a competitive market. In the case of the EMU, we do have 12 market players and for the moment at least four buyers. Nevertheless, it seems unrealistic to assume that the TDR market will be a competitive market without some form of regulation.

However, ten new Member States joined the EU on May 1, 2004, but they did not introduce the single currency straight away. In order to be able to adopt the euro, a Member State must have observed the normal fluctuation margins provided for by the European exchange-rate mechanism (ERM-II) for at least two years without devaluing its currency. Furthermore, their deficit must be less than 3 % of GDP and government debt lower than 60 % of GDP. Three Member States (Estonia, Lithuania and Slovenia) joined ERM-II on June 28, 2004 and wish to adopt the euro as soon as possible. However, a Member State joining ERM-II in 2004 can not meet the exchange-rate criterion until 2006; this means that the new Member States can not adopt the euro before 2007.

Will transactions of TDR's be bilateral or will the rights be pooled and sold by an ECB-subsidiary? The TDR-market is likely to suffer from asymmetric information[188]. Consequently, it will be hard for the seller to determine the marginal value of a TDR for another national government. In bilateral trading, some countries will end up paying different prices depending on which countries they bargain with, the amount and quality of information they possess and their bargaining power which in turn depends largely on their political power and weight. It is also possible that some countries will not sell their TDR's, but trade them for a (geo-)political favour (e.g. participation in war). For all the reasons mentioned above, the market needs a regulator preferably the European Central Bank (ECB).

[188] A key feature of auctions is the presence of asymmetric information. A market for TDR is a basic example of a private-value model where each bidder knows how much she values the object for sale, but her value is private information to herself (Klemperer, 1999, p. 229).

According to Casella (1999), a continuous double auction may be the appropriate trading mechanism for a market in deficit permits. A double auction is a market mechanism through which multiple buyers and multiple sellers exchange goods. Both bids and asks are permitted and exchange can happen at any time during the trading period. Trades therefore take place at different prices and net trades are the result of many bilateral transactions. Continuous double auctions have been the object of a large volume of experimental work. Friedman (1984) and Friedman and Ostroy (1995) have conjectured that double auctions induce competitive behaviour even in the presence of few large players through a form of Bertrand competition: " (…) in order to realize any gains from exchange, a trader must either seize the market price, or accept the market price of another. This necessity both limits each agent's influence on prices (via Bertrand competition[189]) and also conveys high quality information to other agents" (Friedman, 1984, p. 71). Although this argument is intuitively convincing, the formal result requires that players have knowledge of the market clearing price[190]. In experiments, double auctions consistently outperform other exchange mechanisms when market power can exist (Smith et al., 1982), and yield competitive outcomes even when one side of the market, sellers for example, are given the opportunity to coordinate actions in pre-play communication. According to Casella (1999), participants will quickly recognize their common interest, "conspiracies" form and informal agreements to impose cartel prices are easily reached. However, these agreements unravel just as quickly during the play of the game[191]. Consequently, this mechanism seems an appropriate system for a tradable deficit permit market. Furthermore, the continuous double auction should be computerized, a feature that reduces transaction costs and can protect anonymity. Exchanges would take place through a two-tier system: first,

[189] Bertrand competition is a model of competition used in economics. Specifically, it is a model of price competition between duopoly firms which results in each charging the price that would be charged under perfect competition, known as marginal cost pricing. It is also defined as a bidding war in which the bidders end up at a zero-profit price.

[190] In most experiments, as discussed by Casella (1999), players acquire experience with the rules of the game through stationary repetitions of periods of exchange, and thus can use the previous period final price as a good guess of the equilibrium price. The view that these experiments come to approximate games of complete information seems plausible, but raises the obvious concern that the experiments may then not be faithful to the experience of real world markets.

[191] The continuous double auction has two features which may be responsible for this. First, the continuous nature of the auction implies that the temptation defect is continuous too, as opposed to the single act of quoting the cartel price once in a static auction. Second, any access to the market requires a seller to underbid the current ask price; thus, unless the cartel has also agreed to a credible ex post partition of the profits, the agreement will not be sustainable.

direct bilateral negotiations between countries or negotiations via the ECB and second, a simultaneous electronic and anonymous double auction[192].

6.2.3.4. Price information

For the TDR-system to be efficient, the price of one TDR should equal the marginal external cost it creates, i.e. the marginal loss of GDP in the Eurozone because of crowding-out effects. Obviously, there are also external benefits of increased spending by a national government, especially for the export-industries of neighbouring countries. The latter countries might, therefore, be willing to sell their TDR's at lower prices than distant countries.

Using the framework developed by Soberg (2002), we compare the current situation with the 3% cap which will show each Member States' commitment for fiscal deficit spending reduction[193].

Table 19: Fiscal deficit reduction for each Member State

Member State	Business-as-usual 2003 (deficit in % of GDP)	Cap (deficit in % of GDP)	Fiscal deficit reduction commitment (in % of GDP)
Austria	1.1	3.0	0 (-1.9)
Belgium	-0.4	3.0	0 (-3.4)
Finland	-2.3	3.0	0 (-5.3)
France	4.1	3.0	1.1
Germany	3.8	3.0	0.8
Greece	4.6	3.0	1.6
Ireland	-0.1	3.0	0 (-3.1)
Italy	2.4	3.0	0 (-0.6)
Luxemburg	-0.8	3.0	0 (-3.8)
The Netherlands	3.2	3.0	0.2
Portugal	2.8	3.0	0 (-0.2)
Spain	-0.4	3.0	0 (-3.4)
Eurozone	*2.7*		*0 (-0.3)*

Source: Eurostat 2005 and own computations

[192] A similar dual structure exists in most financial markets: for example the "upstairs" and "downstairs" market of the New York Stock Exchange. The downstairs market is the main market, organized as a computerized double auction and the upstairs market is reserved for very large trades that could not be concluded without delay through the main market but are closed through the dealers' personal negotiations. If the downstairs market is sufficiently liquid, it can exercise the necessary disciplinary effect on the upstairs market (Casella, 1999).

[193] Soberg (2002) compares a hypothetical business-as-usual scenario with the cap to calculate the reduction commitment. However, we will use the current situation and compare this with the cap to propose a calculation method for the price of a tradable deficit permit in 2003.

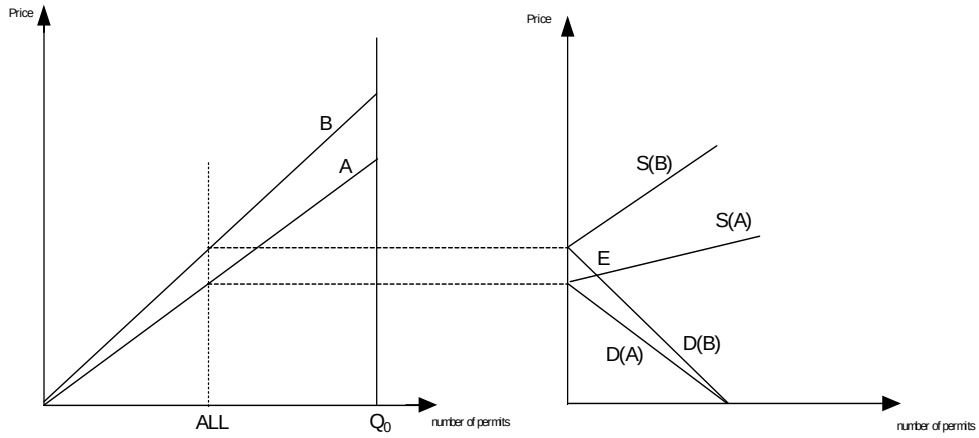
At first sight, demand for TDR's is weak relatively to supply as a result of what the price might become zero[194]. However, it could well be possible that France and Germany need all excess permits of the other Member States to cover their deficit.

Deficit reduction commitments may be implemented as a combination of domestic reduction or net purchase of TDP. The marginal reduction cost of tradable deficit permits is the effect on GDP of more deficit spending, taking into account the multiplier of governmental expenditures and future taxes (because of the additional investments). Begg et al. (2004, p. 1027) state that an increase of 1 percentage point of GDP in public investment or purchases of goods and services adds 0.7 per cent to GDP in Germany, France and Italy, while it varies between 0.5 and 0.6 per cent in the Netherlands, Belgium, Ireland, Portugal and Austria. In Finland and Greece, the multipliers are closer to those of the larger countries. According to Brunila, Buti and in 't Veld (2003, p. 13), the impact of a 1 per cent of GDP increase in government outlays varies significantly across spending categories and over time, but the pattern is roughly the same in all countries. While the multipliers are in the range of 0.5-0.7 and the short-term impact of government purchases of goods and services as well as government investment is somewhat smaller than that for employment. The expansionary effect of higher government purchases would fade away rapidly over the medium term, whereas that of government investment would have a more lasting impact by raising public capital stock and potential output. The smallest expansionary effect in all countries is achieved through a temporary increase in higher government transfer payments, most of which is saved.

These multipliers can be used to calculate the effects of deficit spending on GDP and consequently the marginal abatement costs. Once these costs are known, they can be arranged and transformed into aggregate quota demand and supply curves.

[194] A zero price is acceptable because, in that case, the total burden of governmental lending on the Euro-market is less than 3 % of European GDP.

Figure 8: Derivation of the market demand and supply curves of tradable permits



Source: Based on Weber (2002, p. 285) and Soberg (2002)

The equilibrium position corresponds with the point *E* and the trading of permits that occurs satisfies the equi-marginal principle, because *E* corresponds, in effect, to the intersection of the segments of the two parties' respective *MAC* curves. This analysis only holds for the case of two Member States (A and B). As additional Member States participate in permit trading, some that initially were buyers may become sellers, and vice versa. However, regardless of the number of Member States involved in the markets of permits, a single equilibrium price for permits, ensured by the forces of competition, guarantees that all countries will reduce deficit spending to the point at which marginal reduction costs are the same for all.

As indicated by Soberg (2002), the competitive trading volume and the market-clearing permit price will result from the intersection of permit demand and permit supply[195] and can be obtained by the horizontal summation of the individual parties schedules. This general analysis is applicable to a broad range of problems in which the government limits the use of a particular commodity and allows trading in the rights to that commodity. The importance of calculating the expected market-price is self-evident. Not only will this knowledge improve political and social acceptability[196], it is also a focal point on which bids are made despite the

[195] The equilibrium price will occur at the level at which the quantity of permits demanded by both (or all) polluters equals the cap, and the marginal cost of reducing emissions is the same for both (or all) polluters.

[196] Regulated parties have to be convinced of the advantages that trading permits offers them because if not, no trading will occur.

existence of uncertainty underlying permit demand and supply (Soberg, 2002, p. 272).

Concluding, the price of a tradable deficit permit can be calculated beforehand if marginal reduction costs are known. Marginal reduction costs can, at their turn, be calculated based on multipliers. The marginal reduction cost of a tradable deficit permit is the effect on GDP of more deficit spending, considering the multiplier of governmental expenditures and future taxes. However, it was not our objective to calculate a price for TDR, we have just tried to propose a calculation method that can be used.

6.2.3.5. Monitoring and enforcement

In the current version of the Stability Pact, penalties for countries violating their deficit ceiling are not automatic meaning that compliance with the Pact may or may not be enforced. In a system of TDR, the price would fall to zero if penalties are not enacted. However, even if penalties are imposed and collected, under both schemes, countries will only constrain their behaviour if they indeed bear the final responsibility for such penalties. The most direct approach, recommended in this book, is that banks are legally prohibited to lend (or support the issuing of bonds) to public authorities that do not have the required deficit permits. This is an upstream system with three main advantages. First, the system is self-policing and self-enforcing because no additional deficit spending is possible if countries do not have the required deficit permit to do so. Second, there is no elaborate political process à la Stability Pact necessary. Finally, as discussed in the case of environmental markets, upstream monitoring and enforcement systems will significantly reduce transaction costs.

6.2.4. Summary and evaluation of a TDR system

This chapter provides a proposal in which an EMU tradable deficit rights system may be designed to balance the need to create an alternative for the Stability Pact that fits well within the current legal framework. This option represents one practical approach that could be useful launching discussions between the Commission and the Member States on the design of an EMU deficit trading system[197].

[197] For concerns of European policy makers and a complete analysis of implementation issues regarding deficits and debts, the organization of the trade, the participants of a tradable deficit permit system and the enforcement and political economy, we refer to Casella (1999).

Table 20: Summary of TDR proposal

Design Issues	TDR Proposal	Options
Initial start	The trading system can start at the beginning of each year, preferably after 2007 to allow the new Member States to participate.	2008
Unit of exchange	Allowances are defined in millions of deficit-equivalent. Each allowance provides the holder with a right to deficit spending of 100 million Euros.	
Duration of allowances	Allowances can be used to cover deficit spending in one year. They can not be banked to cover deficit spending in future periods. Borrowing is also not allowed.	Banking could be allowed during a business cycle. If unused, allowances can be used to cover deficit spending in future years in the same business cycle.
Ownership	Allowances are owned by the current holders. Holders are Member States or local governments (domestic TDR system). Each year, when the allowances have been used for compliance purposes to cover deficit spending, they are retired and are no longer available for use or trade.	
Role of Member States	Each Member State included in the trading system must surrender annually allowances equal to the amount of deficit spending of the previous year.	
Role of the European Commission/Ecofin	These institutions must distribute allowances to Member States, approve trades (there is likely to be blanket approval of all trades), monitor compliance and impose penalties.	Deciding how many allowances are distributed to trading sources

Role of the banks	Banks can lend (or support the issuing of bonds) to Member States if they have enough TDR to cover this loan.	
Distribution of allowances	Through free allocation and continuous double auction.	Updating scheme where information on GDP's is updated each year en allowances are distributed based on last year's GDP.
Amount of allowances available for trading.	The number of allowances distributed by the European Commission is set by the Stability Pact provisions, namely 3 % of the GDP of all Member States.	The European Commission can choose another cap each year, dependent on the economic situation.
Compulsion of the system.	It is compulsory for all Member States of the EMU.	
Penalties in case of non-compliance	Because banks are legally prohibited to lend to public authorities that do not have the required deficit rights, the (upstream) system is self-enforcing. In case of offense, banks and Member States have to pay a fine.	The European Commission will set minimum penalties on banks and Member States. It is also possible to impose only fines on banks in case of non-compliance.
Market power	Bilateral trading imposes the risk of more bargaining power of larger countries because of their political power and weight.	The European Central Bank can be used as a regulator. A continuous double auction can be used which needs to be computerized. Exchanges would then take place via direct bilateral negotiations between countries or via a simultaneous electronic and anonymous double auction.
Reference price	If marginal reduction costs are known (which is the effect on GDP of more deficit spending, considering the multipliers of government expenditures and future taxes), a price can be calculated.	
Inclusion of other sources.	Yes, a domestic TDR system is also possible, where allowances are distributed among local governments.	

There are many reasons why the use of property rights, such as the TDR system, is particularly promising for regulating public deficits.

First of all, the transnational external effect of a national deficit will be fully internalized by the TDR system. The system gives some degrees of freedom to countries to deal with a temporary economic crisis. Countries can choose to incur larger deficits by purchasing permits on the market. Member States that remain below the 3 % deficit of the GDP, can sell their unused permits and will gain from fiscal discipline. Member States that exceed the limit, will have to buy permits but it is expected that their price will be lower than the very high penalties described in the Stability Pact.

Secondly, the TDR scheme promotes fiscal discipline, because every country has to meet the standard or buy extra deficit permits. Thus, the total budgetary deficit is fixed in the Eurozone while Member States are allowed some flexibility by trading deficit permits among each other.

Thirdly, a TDR system gives freedom to individual nations and restores their sovereignty. This is important and may tempt Great Britain to join the EMU. Great Britain claims that the transfer of monetary and fiscal competencies from national to union level will mean that economically strong and stable countries have to cooperate in the field of economic policy with other, weaker, countries that are more tolerant to higher inflation. The TDR system restores some of that sovereignty to the Member States.

Finally, the system destroys the arbitrary and political mechanism of granting exceptions to nations that cannot maintain the 3 % limit. If the system is well designed, it will be transparent and predictable. A tradable deficit rights system scores well on transparency because countries that exceed the 3 % ratio will have to buy extra permits at the TDR market or have to pay a fee for every permit that is missing. At this moment under the Stability Pact, penalties are rarely carried out and this undermines its credibility.

6.3. Macro-economic aspects

6.3.1. Business cycles

One of the most well-known and appropriate criticisms of the Stability Pact is that the individual situation and performance of a national economy are not taken into consideration. The maximum budget deficit remains 3 % in every phase of the national business cycles. In addition, the excessive deficits during recessions are being punished while too low surpluses in times of economic boom are not dealt with.

A system of TDR however offers cyclical flexibility. Countries are now able to opt for excess deficits in times of recession, if they are willing to buy more deficit rights. Therefore, the system offers a sort of 'fine' for those countries who have to buy extra deficit rights. Countries that do maintain budgetary discipline are now being rewarded because they can sell their excess TDR. This mechanism works also and especially in times of economic boom.

In the Stability Pact, the 3% norm can only be exceeded when a country is confronted with a serious recession[198]. This exemption is only permitted when the recession is diagnosed. Because of the business cycle, the allowed extra budgetary efforts will be pro-cyclical. TDR allow to interfere in an earlier phase and to conduct an anti-cyclical policy.

When all countries in the Euro zone are simultaneously hit by an economic depression, then, the possibility exists to raise the European cap (3 %). Consequently, the amount of TDR can be made dependent of the European business cycle. At first glance, raising the cap seems just as arbitrary as overlooking the excessive deficits of France and Germany. However, the major difference lies in the fact that only the cap is changed, *not* the rules of the game. The 'ad hoc' character of exceptions for certain countries undermines the credibility of the monetary policy of the ECB. The announcement of the margin for the entire Euro zone, for example by Ecofin or ECB, is part of a general economic policy. Additionally, raising the cap will not create spill-over effects because the new policy is the same for all Member States.

6.3.2. Character of the budget deficit

Critics of the Stability Pact state that, for the sustainability of government expenditures, it matters if the budget deficit stems from consumption or investments. According to the classic public finance theory, consumption expenditure needs to be covered by tax revenues and investments by loans (Musgrave and Musgrave, 1989). A budgetary deficit is permissible for investments in public infrastructure because those investments also contribute to the future economic growth and form the tax base for the repayment of the government's debt. The Stability Pact however does not discriminate between consumption and investment expenses of the government.

In principle, the TDR system can make that distinction while loosing part of its simplicity. The deficit rights, that give national governments access to the European money market, can be earmarked. Otherwise said, the

[198] There exists an exception on the 3 %-rule when a country is confronted with a decline of the real GDP of more than 0,75 %. In all other cases, Member States have 8 months to take counter measures.

financial means obtained by exercising a deficit right can be earmarked for investments expenses. This is, however, not really desirable because the system loses then one of its most important trumps. The advantage of TDR lies in the fact that the Ecofin council does not have to deal with which country has a deficit and for which reason, but only has to take into account the global picture. As soon as stipulations are connected with TDR, monitoring costs will increase. As a consequence, the Ecofin council will have to take disputable decisions with regard to the investment character and earn back effects of certain governmental expenses. Therefore, proponents of the system of TDR want to avoid these kinds of discussions.

6.3.3. National debt

Although limited national debt is a condition for entering the EMU[199], the Stability Pact does not place a disciplinary-procedural connection between the budget norm and the debt ratio. Regardless of the volume of the national debt, all countries are allowed to have a budget deficit of 3 %. Nevertheless, this 3 %-rule is derived from the national debt norm. To limit the growth of the national debt and the resulting effect of interest payments on the public budget, the Pact has chosen for a stable debt ratio of 60 % with respect to the GDP. Since a stable debt ratio approximately equals the deficit ratio divided by the economic growth (Van Poeck, 1999), a debt ratio of 60 % with an (optimistic) growth of 5 % allows maximal a budgetary deficit of 3 %. It follows that countries with a lower debt ratio have more space for temporarily budgetary deficits and that financial markets will offer them those incidental means because of their solvability. On the other hand, a similar deficit of a country with high debts will soon lead to interest snowball effects.

Consequently, macro-financial principles shape the foundations of the budget norm of the Stability Pact. In principle, it is possible to determine for every single country the budget norm in function of the national debt. Consequently, the budget norm for countries with a high historical debt could be reduced to zero (or less). Although the system of TDR can also perfectly accommodate this, countries with high debts maintain the possibility of holding a temporarily budgetary deficit.

The distribution of tradable permits can occur according to different scenarios: an equal or a historical distribution. Usually, an equal distribution has the least social-political resistance. Also the administration costs are low because, once the cap is set, there is no need to considerate other parameters such as national debt. Presumably, these are the reasons why the European politics will choose this distribution model.

[199] The Treaty of Maastricht stipulates that the debt ratio should not exceed 60 % of GDP.

The distributive consequences of the different allocation scenarios are the same because of the tradability (Lyon, 1986). The rights will end up there where they yield the highest benefit. Therefore, the distribution scenarios are important mostly because of the legitimacy in the society and with policy makers. Because of the tradability of the deficit rights, countries with high debts still have some possibilities. Finally, distributing TDR based on national debt would enable the transition countries with a relative low debt ratio to have temporary higher deficits and invest in their public infrastructure.

6.3.4. Demographic situation

The Stability Pact also does not take into consideration the demographic situation and development of a country. However, this is important when setting the socio-economic and financial dependence coefficients[200]. The dependence ratio determines the ability of the government to fulfil their financial and social obligations. The Stability Pact only considers the sustainability of the actual national debt, not the future obligations. An example is the retirement payments of the ageing European societies. These retirement payments hypothecate the capability of the government to pay off their debts in the future. Therefore, it is argued to add the actualised value of the pension burdens to the national debt or to impose a lower debt ratio in function of the dependence coefficients. When distributing TDR, besides the actual national debt, it is also possible to consider the impact of the demographic developments on public finance. In principle, this is even possible in the Stability Pact by limiting the maximal allowed deficits for each country.

6.4. Germany

Germany and France both exceed the deficit limit of the Maastricht Treaty for more than three years (2002-2004). Meanwhile, the European Commission challenged the refusal of the European Council to act upon the repeated failure to meet the deficit criterion before the European High Court (Bizer, Rahahleh and Sesselmeier, 2004). Moreover, Germany's finance minister Hans Eichel indicated in 2003 that Germany would not be able to reach a balanced budget by 2006 (Fatás et al., 2003, p. 2). The main reason is that the local governments and states (Länder) question the constitutional status of the Pact, and they do not comply with the total allowed deficit spending. Furthermore, it was stated that the situation in Germany reflected a desperate attempt to redistribute the burden of transfers related to the

[200] Socio-economic dependence coefficient = non-working population/ working population. Financial dependence coefficient = unemployment benefits/wages. Because of the ageing population in the European Union, these coefficients show an increasing trend.

German unification[201] (Collignon, 2004). However, not only the transfers due to the unification have led to excessive deficits. Also the ageing of the population probably will lead to substantial pressures for increased public spending if no significant reforms are undertaken (von Hagen and Strauch, 2001, p. 32).

The implementation of a tradable deficit rights system can also be decentralized to lower level jurisdictions (regions, municipalities, etc.) as long as they have borrowing authority. National governments would then have to set a domestic procedure for re-allocating their national quota to lower level authorities (Collignon, 2004b). This solves one of the vexed problems of domestic stability pacts, which have been a major obstacle for meeting the Maastricht criteria in federalist states, such as in Germany.

In the first paragraph, we will discuss the current Germany's federal political structure. Then, we will analyze the fiscal relations in Germany and the spending and deficits of the Länder. Finally, we will design a tradable deficit permits system where local governments, next to the federal government, are allowed to borrow and trade permits.

6.4.1. Germany's federal political structure

The Federal Republic of Germany (FRG) has a political system with a pronounced federalistic structure with three levels of government: federal, state (Länder) and local. Before German reunification, there were 11 Länder in the former West Germany; with German unity the number of the Länder increased to 16 (Seitz, 2000, p. 188). Three large German cities, namely, Berlin, Hamburg and Bremen, form their own states. These are the so-called "city-states" (Stadtstaaten) that do not have local administrative bodies. In contrast, the other German states are called "non-city-states" (Flächenländer).

The Länder are not mere provinces but states endowed with their own powers. These powers and responsibilities are specified in the German constitution (Grundgesetz). The constitution also guarantees the local authorities the right to independently administer their own affairs. As the local authorities rely heavily on grants from the states, their independence is rather limited. There exists an important difference between the budgets of city-states and non-city-states. Budgets of city-states include expenditures and revenues that are part of the local budgets in non-city-states. Moreover, the expenditures of the non-city-states include grants to the local authorities

[201] German unification implied the extension of West Germany's social security and assistance institutions to East Germany and the inclusion of East Germany into the federal grant system. The full inclusion of the new Länder into the system led to an overall increase of transfers, particularly of unemployment related benefits (von Hagen and Strauch, 2001, p. 18-19).

whereas there are no such grants to local authorities in the city-states. Consequently, public expenditures or public debt of the two types of state are not directly comparable (Jochimsen and Nuscheler, 2003).

The German federal fiscal system is based on budgetary autonomy of the different layers of government while simultaneously attaching a high importance to realizing broadly equal living conditions across the federation (Wurzel, 2003, p. 4). Because the German states manage their fiscal policy independently of the federal government, the promise of the German federal government, and especially the rigorous interpretation and sticking to the Maastricht rules by the German Federal Minister of Finance is rather hard to achieve if the states do not stay in line and follow a fiscal policy than runs counter to the Maastricht guidelines (Seitz, 2000, p. 185).

6.4.2. Fiscal relations

Although the Länder are endowed with extensive powers, an almost total lack of tax setting autonomy exists. According to Jochimsen and Nuscheler (2003), the situation in Germany therefore differs in one major aspect from the theoretical literature on the political economy of public expenditures. Namely, typically the government has two options for financing expenditures – taxes and debt. But, due to the lack of tax setting autonomy and the equalization scheme, the total revenue of every Land is more or less fixed. Consequently, to finance public expenditures, Länder governments only have one discretionary source of financing at their disposal, namely debt.

Under the terms of the Stability and Growth Pact, Germany is obliged to observe a general government deficit limit and to accept sanctions including fines in the event of non-compliance. However, under present conditions, the Länder could run excessive deficits at the expense of the federal state which would have to bear the fines under EU regulation. Furthermore, there are several other reasons why the fiscal relations between the various levels of government are at the fore of the policy debate (Wurzel, 1999, p. 4). First, the integration of the new states is producing greater financial strains than anticipated. Secondly, the Stability and Growth pact at the European level has raised questions as to how the international commitments to fiscal consolidation can be efficiently and equitably allocated between different levels of government. Finally, there is the issue of whether an efficient public sector could be achieved through greater conformity with the constitutional principle of subsidiarity.

In order to solve some of these issues, the German government has proposed to determine Maastricht deficit limits both vertically between the Bund and the Länder, and horizontally across the Länder. Such budget caps would only apply in the event of an excessive budget deficit as defined in the

Maastricht treaty. Other federalist countries in Europe, such as Austria, Spain and Switzerland, have also introduced rules to contain the deficits of the central and decentralized governments. However, it is an open question whether commitments will be held without enforcement mechanisms. In Austria, whose federalist structure resembles Germany's in many respects, all three layers of government recently agreed on sanctions in case of a party's non-compliance with negotiated budgetary targets (Wurzel, 2003, p. 17). However, the issue of penalizing individual Länder stands in potential conflict to the principle of fiscal equalisations.

6.4.3. Spending and deficits of the Länder

The updated German Stability program of December 2003[202] and the new fiscal planning aim, first, to reduce the deficit rate in order to meet the standards of the Stability Pact and, in a longer term, to achieve a close-to-balanced budget. According to the current status of the fiscal planning, the deficit rates will decline in the medium term from -4% in 2003 to -1.5% in 2007. In the following table, the deficits and GRP[203] of the Länder are shown for 2001 to illustrate the current situation.

Table 21: Deficit of the Länder (2001)

Länder	GRP (in million Euro)	Deficit (in % of GDP)
Baden-Württemberg	301.663	0.79
Bremen	22.448	1.66
Bavaria	360.783	0.05
Hamburg	73.570	1.36
Hesse	188.055	0.71
Lower Saxony	180.426	1.55
Nord Rhine-Westphalia	458.078	1.42
Rheinland-Palatine	91.042	1.36
Schleswig-Holstein	64.505	1.02
Saarland	24.780	0.08
Berlin	76.189	6.43
Mecklenburg-Western Pomerania	29.168	2.30
Saxony	74.241	0.17
Thuringia	40.139	1.76
Saxony-Anhalt	42.528	2.04
Brandenburg	43.583	1.66

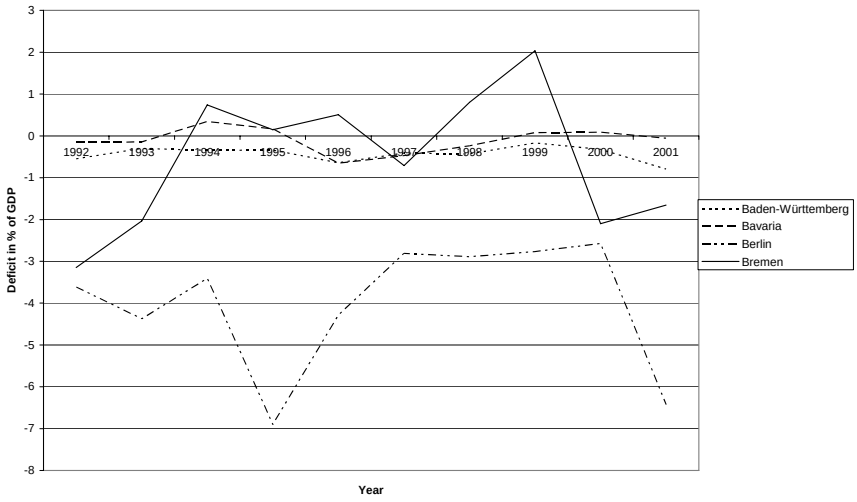
Source: Jochimsen and Nuscheler (2003).

[202] The federal government and the states agreed on new legislation, which specifies that all parties, including the communities, should aim at balanced budgets. Moreover, the inter-governmental Financial Planning Council is attributed the tasks of making recommendations on how to accomplish or restore fiscal discipline and to monitor whether the authorities' spending and budget balances evolve in line with the targets set and the requirements of the EU Stability Pact. However, violations will not be subject to sanctions (Wurzel, 2003, p. 17).

[203] Gross Regional Product.

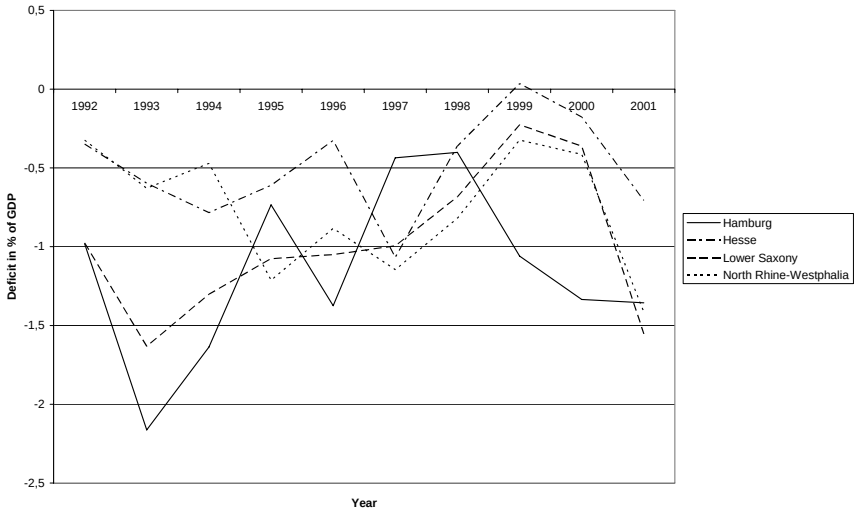
The table clearly shows that in 2001, only Berlin exceeded the 3 % deficit rule. This is understandable, because, the deficit level of the whole federation in 2001 was below the 3 % level, namely -2,8 %. In 2002, Germany started violating the Stability Pact[204]. In the first appendix, we will illustrate the amount of deficit spending throughout the years, starting from 1992 until 2001 for all Länder[205]. These results are summarized in the following figures. First, deficit spending in % of GDP of the West German Länder is illustrated for the period 1992-2001.

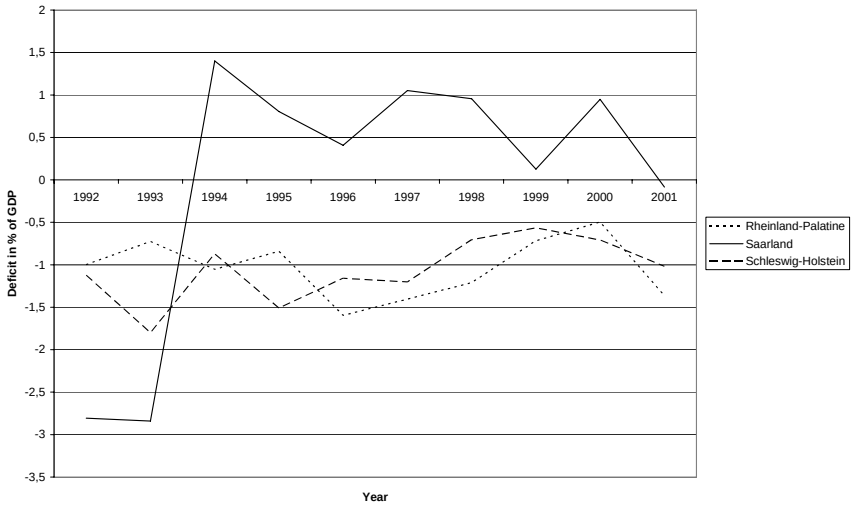
Figure 9: Deficit in % of GDP of the West German Länder (1992-2001)



[204] However, it is very difficult to compare federal data with state level data. The federal debt is debt issued by the federal government and this is something completely different from the aggregate debt level issued by German states. Applying the 3 % deficit rule to a federal country like Germany is therefore not straightforward. Three governments, namely federal, Länder and communities, can issue debt. The data used in this analysis do not include debt by communities which can cause federal deficit level and aggregate Länder deficit level to differ. More recent data were unavailable.

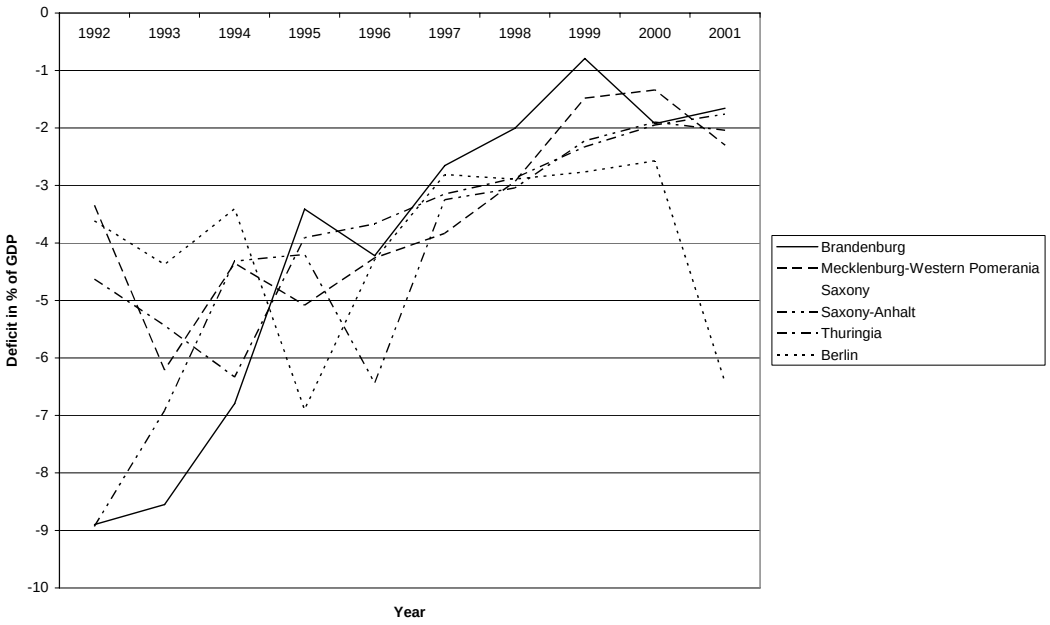
[205] For some Länder, the deficits for 1991 are unknown. Therefore, we start our analysis from 1992.





This figure shows that deficits of all Länder range between 0 and -2 % of the GDP, except for Berlin. However, deficit spending of some formerly West German Länder is increasing. Second, we take a look at the new Länder in East Germany. This figure shows that the East German Länder have already significantly reduced their deficit spending in the last 10 years.

Figure 10: Deficit in % of GDP of the East German Länder (1992-2001)



Referring to the current status of fiscal planning in Germany, it is predicted that the overall debt rate will temporarily rise in the medium run to 64.5% and will only decline towards the Maastricht reference figure of 60 % after 2007. The following table shows the debt of the 16 Länder in % of GDP. It clearly demonstrates that, in 2003, only three (Western) Länder had reached the Maastricht criteria, namely Bavaria, Baden-Württemberg and Hesse. All other Länder exceeded the criteria. Moreover, Berlin has the largest debt in percentage of GDP.

Table 22: Debt of the Länder in % of GDP (2003)

Länder	**Debt in % of GDP**
Baden-Württemberg	*52.1 %*
Bremen	83.9 %
Bavaria	*48.2 %*
Hamburg	63.6 %
Hesse	*56.8 %*
Lower Saxony	66.5 %
Nord Rhine-Westphalia	65.0 %
Rheinland-Palatine	67.4 %
Schleswig-Holstein	70.3 %

Saarland	69.1 %
Berlin[206]	101.6 %
Mecklenburg-Western Pomerania	77.6 %
Saxony	60.5 %
Thuringia	76.8 %
Saxony-Anhalt	83.8 %
Brandenburg	78.6 %

Source: Geldner, 2005

Currently, the Federal and Länder governments are continuing their combined strategy of structural reforms and consolidation of the public-sector budgets. They are thus taking account of both the short-term economic stabilization objectives and the medium-term and long-term targets of the Stability and Growth Pact. In the Ecofin Council recommendations (Federal Ministry of Economics and Labour, 2004), the following obligations were set out for Germany: Germany is to return below the 3% threshold in 2005, to undertake a structural deficit reduction of 0.6% in 2004 and of 0.5% in 2005, and thereafter to reduce 0.5% a year. These Ecofin recommendations are more difficult to attain for some Länder than for other. Therefore, in order to meet the different needs of the 16 Länder, a system of tradable deficit permits could be set up in Germany to reach the Council's recommendations. The design of such a system will be discussed in the following paragraph.

6.4.4. Tradable deficit permits in Germany

6.4.4.1. Initial distribution

Regarding the distribution of deficit rights between states and the federal government, some Länder may argue for a distribution in line with past deficits motivated by the perception that high deficits can not be turned around over night. However, distributing deficit allowances based on past deficits will not be welcomed by low deficit states, which believe that it implies a punishment for a policy of fiscal austerity in the past and adds to existing disincentives for economical usage of resources. For efficiency reasons, a distribution per capita is preferable because this implies that the deficits of the new Länder would have to fall significantly, given that the eastern states account for 21,5 % of the population and for 35% of the overall Länder deficit in 1997 (Wurzel, 1999, p. 19). However, distributing permits based on population can not be used for the federal government, which is also entitled to a certain amount of deficit spending. Alternatively, the allocation of deficit rights could be made based on both investment and population shares. To the extent that the average investment of the new Länder will level off with their catching up economically with the rest, the

[206] Because of budgetary reasons as already mentioned, public debt of city-states are not directly comparable with those of non-city-states.

two latter distribution methods should produce similar allocations of rights in the medium term.

A more radical solution would be to auction deficit rights among the Länder and federal government. Assuming that deficit permits are acquired by those states which utilise above-average deficits for financing public investment, the auction principle should again produce deficit allocations which are similar to the population-based rule in the medium term. According to Wurzel (2003, p. 20), it is then preferable to implement the latter. However, a transitory period seems necessary in which past deficits are regarded. It remains an open question whether deficit restrictions which are auctionable would be perceived by the Länder to be as binding as fixed rules or whether the risk of overruns would increase. Also, auctions could effectively amount to transfers from the poor states to the rich states.

6.4.4.2. Coordination

With respect to public finance policy and deficit spending for the federation as a whole, a special institution, the Financial Planning Council[207] *(Finanzplanungsrat)*, seeks to achieve consensus and cooperative behaviour between the German federal and state governments (Seitz, 2000, p. 185). This institution can also be used to set-up and administer a national tradable deficit permit system. The use of an existing institution is likely to keep transaction costs low. Furthermore, it will also ensure the quality, transparency, timeliness, and reliability of budgetary statistics. In a signalling system, federal government and Länder are kept up to date of the data used and the status of the deficit spending. Such a system would make sense since the federal government and Länder need to be wholly convinced of the quality of the analysis (and of the data used) behind the surveillance and coordination. In that case, the Financial Planning Council states very clear and transparent thresholds that allow it to flag an emerging problem of permit shortage and to assess its severity. Once it is established that a deficit is excessive, the enforcement mechanisms should commence.

6.4.4.3. Monitoring and enforcement

For the implementation of tradable deficit permits in Germany, the technical ability of the governments and the Financial Planning Council to monitor and control the evolution of the budgets is of high importance. As already mentioned, efficient and timely controlling of deficit spending of all layers of government requires that identical and appropriate accounting standards be utilised.

---

[207] The Financial Planning Council, which operates since 1968, is composed of the federal finance minister, the federal minister for economic affairs and the finance ministers of the 16 Länder, as well as representatives of the local governments. The Deutsche Bundesbank has also the right to participate at the sessions of the Financial Planning Council.

Non-compliance should trigger sanctions. One option is to impose fines. These fines should be high enough to induce compliance behaviour but without aggravating the problem ex-post that is to be prevented ex-ante. Another option, in case of non-compliance, is to suspend certain rights of the Länder or the federal government. For example the right to independently administer some affairs or the right to receive permits the next year. Another possibility to ensure the enforceability of the budget rules is to strengthen the disciplinary power of treasury ministers so they can sanction non-compliance with the deficit permit system. It is also possible to create a neutral body with the power to assess and sanction the budgetary and permit behaviour of Länder and federal governments.

It can be expected that these proposals, notably the plan to strengthen the disciplinary power of treasury ministers or the creation of a technocratic body with the power to sanction democratically elected parliaments, will meet fierce political resistance. However, it is our belief that the private market, namely a neutral body, to play a more active role in limiting government borrowing and sanctioning non-compliance does have merit. Furthermore, enforcement measures are necessary since the EU peer-pressure mechanism has failed in fiscal policy[208]. Holding governments accountable will limit the options for deficit spending to improve government finances.

6.5. Transaction costs

Given the objective of imposing fiscal discipline on the countries of the European Monetary Union, what is the most efficient way of doing so? In a market for deficit permits, all Member States will act to equalize their marginal costs of deficit reduction, achieving the 3% target at minimum total cost. Consequently, a system of tradable deficit permits would allocate deficits where their value is highest. Even so, do tradable permits not entail higher transaction costs than regulation? We will look into this question by analyzing all relevant transaction costs of the Stability Pact and tradable deficit permits.

6.5.1. Determination of relevant transaction cost categories

The following categories will be discussed in the comparative transaction costs analysis:

[208] More specifically, the mechanism has collapsed since Germany and France, which both have exceeded the deficit limit from more than three years, are not penalized. Moreover, the refusal of the European Council to act upon the repeated failure is challenged by the European Commission before the European High Court.

– Legislative costs which includes lobbying, political support and legal barriers[209] costs;

– Costs of delay (in policy implementation or execution);

– Information costs about fiscal deficits and the behavior of Member States;

– Search (planning) costs for the appropriate design of the system;

– Operational costs;

– Negotiation costs between Member States or between the ECB or Ecofin Council and the Member States;

– Contract costs;

– Monitoring and enforcement costs; and

– Compliance costs.

6.5.2. Regulation: The Stability and Growth Pact

The essence of the Stability and Growth Pact is to watch the fiscal deficit of each Member State closely and punish those countries whose deficits are deemed excessive. Though important, the other aspects of the Pact are not essential for our analysis.

6.5.2.1. Legislative costs

Schuknecht (2004) has identified a number of reasons why deficit and debt biases are likely to emanate from the democratic political process. Voters and economic agents in democracies are represented by politicians who themselves are aided by administrations. The resulting institutional setup differs significantly across countries but invariously gives rise to several problems. For example, rational (but imperfectly informed) voters can induce politicians to conduct expansionary policies before elections. Distributional conflicts across interest groups or generations can also give rise to deficit and debt biases. Public debt can be a means of distributing money from tomorrow's rich (taxpayers) to today's poor (benefit recipients). Spending biases and inefficiencies can also be reinforced by self-interested bureaucrats who, through various mechanisms, are able to secure budget allocations (expenditures) that are higher than economically efficient. The spillovers that could arise from these unduly expansionary fiscal policies in monetary union are an argument in favour of fiscal rules (such as the Stability and Growth Pact).

As described by Kirkpatrick and Parker (2004, p. 12), regulatory regimes are prone to capture. 'Regulatory capture' involves the regulatory process of becoming biased in favour of particular interest groups and notably the

[209] Legal barrier costs are the costs of embedding a certain policy in the (existing) legal framework.

regulated entities. Regulation is also subject to 'political' capture meaning that regulatory goals are distorted to pursue political ends. This is most likely to arise when the regulation is directly under the control of the government. Under political capture, regulation becomes a tool of self-interest within government or the ruling elite.

There are several vested interests in the design of regulation. Politicians may prefer complex rules when this opens room for interpretation and discretion and renders a strict implementation more difficult. The administrating agency (the Commission) may also not be immune to the fact that via complex regulation it can gain more influence on the process and receive higher budgetary appropriations. By contrast, financial markets and even more so the public will have an interest in rather simple and clear rules due to compliance costs without ignoring economic rationale.

With regard to enforcement, the Commission will want strong provisions. In contrast, politicians will not want to strengthen fiscal rules unless they receive strong signals from the public and financial markets. The Commission may also have a preference as to enforcement via a centralized approach. If they can take this role, they will be more than simply an assessment agency and secretariat for fiscal contracts between European countries.

Regulation is a frequently used mechanism with little legal barrier costs. More specifically, the Stability Pact (EC Treaty) needed to be ratified by the Member States to be legally valid. No other specifications or procedures were necessary. Consequently, legal barrier costs of regulation, more specifically the Stability Pact, are negligible.

In conclusion, lobbying costs will be substantial, not only in the implementation phase but also in the enforcement phase. Politicians are in favour of complex regulation with no enforcement which increases transaction costs. Bureaucrats prefer regulation with centralized enforcement which will increase their budgets or influence. Legal barrier costs are negligible because regulation is a well-known and often used mechanism which requires no or few adjustments in national legislation.

6.5.2.2. Delay costs

The excessive deficit procedure of the Stability Pact creates costs to the citizens of the countries with an excessive deficit but also to the citizens of all other Euro-zone countries because of the increased interest rate. The relative sanctions arrive too late, if at all. Moreover, the procedure is not sufficiently clear since Member States do not know how they will be treated when they breach the 3% threshold.

Verde (2004, p. 17) states that the flexibility provided by the Pact is of an ex-post nature and as such, reduces the incentives for countries to implement fiscal reforms, encourages moral hazard behaviour[210] and reduces credibility. Verde continues by stating that this ex-post nature is unlikely to induce simple procedures and consequently, very unlikely to prevent crises. However, it is not the ex-post nature that creates crises. For example, also traffic safety is of an ex-post nature. The accident costs are only distributed between parties after the accident has occurred. However, there is an incentive for road users to drive safely before the accident. The same is valid for the current Stability Pact. Countries do have an incentive to limit their deficit spending but the distribution of the costs of a violation of the Pact only occurs after the excessive deficit spending has occurred. The delay costs stem from the lengthy procedure as shown in the following timetable.

Table 23: Timetable of the steps in the excessive deficit procedure

	Year *N*	**Year *N+1* and thereafter**
March	Member states of the EU submit data[211] - Commission prepares report	Member States submit data211
April	Economic and Financial Committee formulates opinion – European Commission prepares opinion	Ecofin decides to abrogate or intensify sanctions
May	Ecofin decides on excessive deficit and issues recommendations	
September	Ecofin assesses 'effective sanctions' and may decide to punish recommendations – Member states submit data211	Member States submit data211
October	Ecofin gives notice of specific measures	
December	Ecofin decides to apply sanctions	

Source: Buti, Franco and Ongena, 1998, p. 96

Speeding up this procedure and predetermining procedural rules is indispensable to reduce delay costs. At the moment, in order to avoid sanctions, the Member State concerned should bring back its deficit below the reference year two years after the occurrence of an excessive deficit and one year after its identification, unless special circumstances are given. The example of the excessive deficit procedure of Germany and France clearly demonstrates the high delay costs. Since 2002, France and Germany's deficits have been above the 3% of GDP Treaty reference value. This led to

[210] Moral hazard behaviour is encouraged because the Ecofin Council's refusal to impose sanctions on Germany and France, suffering excessive deficits, encourages other countries to more deficit spending in the future.

[211] According to Council Regulation (EC/3605/93), Member States must submit budgetary data twice a year: first until March, 1 at the latest, afterwards until September, 1 at the latest.

an excessive deficit procedure under the Stability and Growth Pact for both countries. The commission requested Germany to reduce its structural deficit by 0.8% of the GDP, and France by 0.4%. However, the Ecofin Council voted in November 2003 against proceeding with these sanctions without genuine economic reasons. On January 13, 2004, the European Commission announced its decision to challenge in the European Court of Justice the legal status and validity of certain elements of the Council conclusions adopted by Ecofin relating to the excessive deficit procedure for France and Germany (HM Treasury, 2004, p. 40). In other words, the procedures of the Pact have never been fully applied. Concluding, delay costs are substantial because of the lengthy excessive deficit procedure and its stipulations.

6.5.2.3. Information costs

The problem with rules and regulation is that they often reflect the economic and intellectual environment of the time when they were designed. Furthermore, regulation is often associated with information asymmetries. The regulator and the regulated can be expected to have different levels of information about matters such as costs, revenues and demand. The regulated Member States hold the information that the regulator needs to regulate optimally and the regulator must establish rules and incentive mechanisms to force and coax this information from the Member States. Since it is highly unlikely that the regulator will receive all the information required, the results of regulation remain 'second best' to those of a competitive market (Kirkpatrick and Parker, 2004, p. 11). However, even when they have been intelligently conceived, the life expectancy of regulatory rules is limited meaning that they have to be changed from time to time. The more rigid and the more context rooted they are, the more frequently they will have to be redesigned and, of course, the less credible they will be. The Stability Pact was designed assuming that governments would accumulate surpluses in good times to allow the operation of automatic stabilizers in bad times. However, the Pact was signed at the end of a long phase of convergence to the Maastricht criteria, which involved procyclical fiscal policies during at least the years 1995-97. Its implementation started at a time when public deficits were rapidly vanishing reinforcing the belief that a situation of balanced budget would be easy to reach. The requirement of a balanced or surplus budget was thus context dependent. Since the end of the US expansion of the 1990s, the Euro area economy has experienced a combination of depressed growth and (procyclical) restrictive fiscal policy. The three largest countries, namely Germany, France and Italy, did not have room for automatic stabilizers to effect, so that fiscal policy was ineffective even facing transitory shocks. This situation is simply unbearable and is resulting in increasing pressure to revise or soften the Pact (Fitoussi, 2002).

The current three percent rule of the Stability and Growth Pact is not cyclically adjusted. Therefore, it interferes with the operation of the national automatic fiscal stabilizers when the three percent rule is in danger of being breached by a cyclically appropriate deficit increase. Buiter (2003) suggests that this risk can be avoided by targeting a cyclically adjusted deficit that is sufficiently far below three percent of GDP. Furthermore, the numerical constraints on deficits and debt of the Stability and Growth Pact are 'one size fits all'. However, there are sizeable and persistent differences among the growth rates of the current EMU members. Another important source of heterogeneity relates to initial conditions, especially the outstanding stock of public infrastructure capital and debt. The current rules pay no attention to amount of outstanding debt in relation to the deficit rule[212]. The three percent deficit rule applies equally to Belgium, Italy and Greece as to Luxembourg, Finland and Sweden. Yet, at the end of 2001, gross general government debt as a percentage of annual GDP was 108.2 for Belgium, 108.7 for Italy and 99.7 for Greece, while Luxembourg's scored 5.5 %, Finland 43.6 % and Sweden 52.9 % (Buiter, 2003)[213]. A three percent rule for all Member States does not handle these differences. Consequently, for an efficient rule, which takes into account all the differences between the Member States, information costs will be much higher.

In general, information costs are higher in an international context than at the domestic level. In case of efficient regulation, more market players and more differences between market players increase information costs. However, a 'one size fits all' rule as used in the current Pact substantially decreases information costs.

6.5.2.4. Search (planning) costs

The Maastricht Treaty has defined the sustainable debt level to be 60 % of GDP. The corresponding budget deficit consistent with this target debt ratio was put at 3 % of GDP. It is well known that the 3 % deficit norm will indeed ensure that the 60 % debt ratio can be kept constant provided the nominal growth of GDP is 5 %[214]. It has been noted by many economists that these numbers are quite arbitrary (Buiter, Corsetti and Roubini, 1993). The debt ratio happens to be close to its average for the EC in 1991 (61.7%), the deficit ratio is below the 1991 EC average of 4.3%. There is no reason to believe that current EU averages are optimal for the EU as a whole, let alone

[212] Although limited national debt is a condition for entering the EMU, the Stability Pact does not place a disciplinary-procedural connection between the budget norm and the debt ratio. Regardless of the volume of the national debt, all countries are allowed to have a budget deficit of 3 %.

[213] Net general government debt as a percentage of GDP at the end of 2001 was as follows: Belgium: 98.9; Italy: 96.5; Finland: -47.9 and Sweden: 1.0 (Source: OECD).

[214] This follows from the steady state relationship between deficit and debt ratios for given nominal growth rate of GDP, i.e. d = b y, where d = deficit as percentage of GDP, b = the debt as percentage of GDP and y = nominal growth rate of GDP.

for each of the individual Member States which differ in economic structure and initial conditions. Consequently, Buiter, Corsetti and Roubini (1993) question the economic logic behind the choice of 3% for the deficit-GDP ratio. They state that the Maastricht guidelines are too tight, unless EMU really does achieve zero inflation and public sector investment does not rise above 3% of GDP (p. 63).

To conclude, there exists a trade-off between search and planning costs on the one hand, and the efficacy of the regulation on the other. With regard to the Stability pact, search costs were rather low. However, the efficacy of the Stability Pact is also often questioned. Furthermore, the lack of differentiation between the Member States adds to this critique.

6.5.2.5. Set-up costs

With the rise of the European Union, institutions have been set up to administer all relevant aspects. The set-up of the Stability Pact, and more specifically the excess deficit procedure, was incorporated into these existing institutions. The European Commission has the task of monitoring budgetary developments and the stock of public sector debt of the Member States, checking in particular their compliance with two reference values for the ratio of the deficit to GDP and the ratio of public debt to GDP. If a Member State does not comply with these reference values[215], the Commission prepares a report for the European Council. Furthermore, the Economic and Financial Committee (EFC) advises the Council in these matters. If the Commission believes that an excessive deficit exists, it sends its opinion to Ecofin and makes a recommendation for the Council to decide that a deficit is genuinely excessive. Voting on these recommendations, it is the Ecofin Council that decides whether or not an excessive deficit exists. Concluding, set-up costs will be relatively low because tasks and responsibilities are taken up by existing institutions.

6.5.2.6. Operational costs

Low set-up costs do not necessarily imply negligible operational costs. The costs of directly administrating the regulatory system are internalized within government and reflected in the budget appropriations of the regulatory body or bodies. The Stability Pact requires several tasks, such as monitoring budgetary developments and debts, checking their compliance, preparing reports and formulating recommendations. These costs are certainly not negligible because of the complexity of the procedure.

[215] This is unless the deficit and the debt are approaching their reference values in a satisfactory way and unless the excess of the deficit over the limit is exceptional and temporary.

6.5.2.7. Negotiation costs

At the origin of the Stability Pact lies a lot of negotiation efforts. The requirement of achieving and maintaining fiscal discipline to join the single currency is at the core of the Maastricht Treaty. A proposal for a 'Stability Pact for Europe' was put forward by the German Finance Minister, Theo Waigel, in November 1995. Negotiations on the pact were conducted during 1996 and the first half of 1997. The politically difficult issue of the 'exceptional' conditions under which a breach of the 3% threshold is allowed, was settled at the European Council in Dublin in December 1996. The final package was adopted by the European Council in Amsterdam in June 1997. Further specifications concerning the implementation of the Pact at the start of EMU were given in the formal declaration adopted by the Ecofin Council during the 'EMU weekend' in the beginning of May 1998 (Buti, Franco and Ongena, 1998). In general, coordination between Member States always generates negotiation costs, incentives to cheat, and possible conflict in the delegation of authority (Jacquet and Pisani-Ferry, 2001, p. 6). In the case of the Stability Pact, these negotiation costs were substantial because of the lengthy deliberations that took place.

Renegotiation costs should also be taken into account when regulating Member States. Furthermore, when a small number of players are contracted, strategic opportunism can be the result. This occurs when one of the contracting parties renegotiates the terms of the contract in their favour during its lifetime. During contract negotiation, either the Member State or the regulating authority could be the loser, depending on the results of the renegotiation.

6.5.2.8. Contract costs

No costs are incurred as a result of contracting over regulation and more specifically the Stability Pact.

6.5.2.9. Monitoring and enforcement costs

First, ex-post monitoring of compliance is indispensable. The surveillance process required under EU law provides for such ex post monitoring and the fiscal thresholds (also called reference values) are formulated relative to ex-post outcomes. Second, there must be a means to sanction inappropriate compliance/performance. The EU fiscal framework is based on EU law which means that fiscal rules are applied in an international law context. Furthermore, neither the Treaty nor the Stability and Growth Pact foresee that sanctions can be imposed automatically[216]. This has some important implications for enforceability (Schuknecht, 2004, p. 12):

[216] The Commission argued that the automatic working of sanctions is impossible because the Treaty provides scope for the Community institutions to exercise discretionary judgment, and this can not be taken away by either secondary legislation or a new international treaty.

1. The Ecofin Council, comprising the Member States' finance ministers, takes all relevant decisions. This implies that the decision making body is not independent and impartial but partisan with all parties, some creating spillovers and others paying for it;
2. Fiscal rules are not litigable so that nobody can go to court if the Ecofin Council does not punish a non-complier; and
3. There is no army or policy that can force governments to comply and, thereby, give up their fiscal sovereignty.

Schuknecht (2004, p. 13) proposes self-enforceable contracts to limit monitoring and enforcement costs, meaning that the incentives of participants are set in a manner that it pays to comply. This can be a solution to an international contracting problem without a proper (non-partisan) court or enforcer. One way to achieve self enforceable contracts is repeated games with sufficiently large profits from behaving cooperatively so that they exceed the gains from opportunism/non-cooperation in net present value terms (Mueller, 1997). If a contracting party does not co-operate, the other parties would not continue the contractual arrangement. However, the EU fiscal policy is more complicated than that. Governments can not simply enforce another country's exit as a result of deficits that are more likely to rise beyond some arbitrary maximum. However, governments would be well aware of the potential long run costs of breaching the contract because it would put their own economic and financial stability, if not of the whole EMU, at risk.

Zsolt de Sousa (2004) suggests the creation of a different sanction mechanism. This suggestion recognises that cooperation between Member States does require some form of enforcement but argues that the existence of financial sanctions is counter-productive, since it is not credible. Consequently, a softer sanction could be created, for example, the imposition of a progressive fine that would take the form of a percentage of GDP that Member States would have to pay on top of their debt service. Zsolt de Sousa (2004, p. 27) argues that this enforcement system will make sanctions more credible, as they would be more easily applied by comparison to the currently existent sanctions that require a non interest bearing deposit by the sanctioned Member State. However, softer sanctions might provide an incentive for misconduct as countries know the price they will have to pay for not respecting the rules. As described in the third chapter, sanctions need to be strong if they are to be effective in their deterrence role. By having softer sanctions, misbehaviour is not prevented from taking place, but, on the contrary, there is a risk of inciting it, since Member States would know that the fine they would incur would be

minimal, especially when compared to the possible gains from taking measures that would imply a deficit rising above the limit[217].

Another development is the introduction of the open method of coordination (OMC) as part of the Lisbon European Council[218]. The emphasis is on consensus-forming with three elements found in each process: common assessment of the economic situation, agreement on the appropriate economic policy responses and acceptance of peer pressure and, where necessary, adjustment of the policies being pursued (Hodson and Maher, 2001, p. 723). The method has been applied to macro-economic policy, the employment chapter of the treaty, social policy and structural policy. The objective of the OMC is 'not to establish a single common framework, but rather to share experiences and encourage the spread of best practice' through the setting of guidelines, the establishment of performance indicators, the translation of targets from European to national and regional levels, and periodic monitoring, peer review and evaluation (Kassim and Menon, 2004, p. 13). Disadvantageous is that this soft coordination method of economic policies is not supported by any sanction but relies on the commitment of states and peer pressure.

In general, monitoring costs rise when rules become more complex. Furthermore, complex rules reduce pressure on policy makers to comply because compliance becomes less clear and transparent for the public. In addition, complex rules are more prone to disagreement, which undermines enforcement and compliance in the political sphere (Schuknecht, 2004, p. 19). The following figure illustrates in a simplified manner the optimality of fiscal rules in different contexts of enforceability. "Soft law"[219] reduces monitoring and enforcement costs by resulting in secondary regulation and processes that facilitate transparency and create a forum to exercise international peer pressure. At the same time, when sovereignty costs are high, meaning that special interests and electorates must be pleased and hard

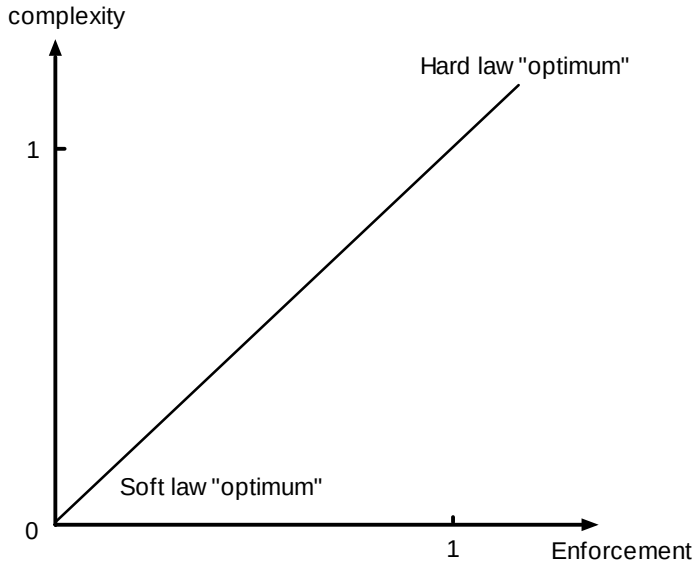
[217] For example, a Member State decides to lower taxes one year before elections. The impact of that tax decline, without the corresponding cut in spending, would initially be a rise in the deficit. A government that wishes to be reelected could prefer incurring a penalty rather than losing the elections, especially if the penalty is soft. As described by Zsolt de Sousa (2004, p. 27), the political cost of not abiding by the rules is high for the government. However, the type of sanction is directly linked to the political cost. Politically the cost of not respecting a rule gets higher when the financial cost of not respecting that rule is also higher.

[218] The OMC draws its inspiration from earlier Council meetings at Luxembourg, Cardiff and Cologne, where a series of supply-sided policy initiatives were set up.

[219] Schuknecht (2004) defines "soft law" as law of which formal enforcement is limited. Because it is often argued that the EU fiscal rules are unenforceable, ineffective and dead, the term "soft law" is used in the political science and international relations literature as the middle between the hard law and no law enforcement. Schuknecht has also identified a number of advantages of soft law over "no law" especially in the international context so that at least some contract compliance and internalization of spillovers can be attained.

law is impossible to attain, soft law might imply that the rules can be bent to some extent to reduce political costs at home (Schuknecht, 2004, p. 14). Furthermore, when rules are not enforceable ('soft law'), they must be very simple so that monitoring institutions with high transaction costs can put pressure on policy makers. At the other end of the spectrum, well-enforced law may require complex rules to enhance their acceptance.

Figure 11: Complexity and enforcement under "soft" and "hard" laws



Source: Based on Schuknecht, 2004, p. 33.

Although the 3% deficit limit is a simple and transparent indicator, the Stability and Growth Pact will induce high monitoring and enforcement costs. Firstly, sanctions are not automatic but can only be executed after a long process of negotiations among EMU Members. The different voting weights in the EU Council of Ministers are an advantage for larger countries because they have more power to stop an excessive deficit procedure. For example, in 2003, the Ecofin Council has rejected a Commission request to take further procedural steps against France and Germany under the excessive deficit procedure. Or, in other words, the rules were not implemented in a strict manner. It can also be assumed that the probability of being sanctioned depends inversely on the number of countries that breach the Stability Pact rules. According to Begg et al. (2004, p. 1029), it is hard to imagine that Member States on the verge of breaking the deficit criterion sometime in the not so distant future will take a tough stance with regard to those countries that already have an excessive deficit. Secondly, if an excessive deficit is decided to be sanctioned, the penalty deposit of a Member State will have to be calculated according to the following formula:

*Deposit in percent of GDP = 0.2 + 0.1 * (deficit – 3% GDP)* (10)

which consists of a fixed amount of 0.2 % of GDP[220] and a variable component of 0.1 % of the difference between the actual budget deficit and the 3 % reference value[221]. This deposit will only be reimbursed if the Council considers that the excessive deficit has been corrected within two years. The pecuniary cost of such a sanction is the interest foregone. If the excessive deficit is not corrected after two years, the deposit is turned into a fine and the Council intensifies the sanctions through the requirement of a new non-interest-bearing deposit which only consists of the variable component of the above formula (Blyumental, 2004, p. 11).

Concluding, monitoring and enforcement costs will be high because of the complicated mechanisms of sanctions, the limited enforceability and the non-transparent negotiation process.

6.5.2.10. Compliance costs

The compliance costs of regulation are external to the regulatory agency and fall on Member States in terms of the economic costs of conforming with the regulations or of avoiding and evading them. For rules to be credible and compliance costs to be low, one of two conditions must be met. Either the rules are self-enforcing, or they are enforced consistently by an external agent (Buiter, 2003).

First, for rules to be self-enforcing, they either must be individually incentive-compatible because they make sense at the level of the individual nation state or they must take on 'totemic' or 'sacral' qualities (Buiter, 2003). The Stability and Growth Pact three percent rule is not self-enforcing by being individually incentive-compatible. The number 3 is arbitrary, and those who propose and defend the three percent deficit ceiling readily admit that they would have been happy with any number, as long as it was low. As regards any totemic or sacral qualities for fiscal rules, there is little prospect of that nowadays.

Second, the rules are also not consistently enforced. The arbitrariness left in the criteria of the Stability Pact creates uncertainty about the application of the penalties and generates difficult negotiations with individual countries which negatively affect compliance. Especially when economic conditions are tough, but not bad enough to qualify for exceptions automatically, the

[220] The fixed amount demonstrates that there is a tangible difference between having and not having an excessive deficit position, and thus, provides an incentive to Member States to make additional efforts to avoid the risk of sanctions.

[221] The variable component is designed to penalise further budgetary misbehaviour in a continuous fashion.

incentive to violate the deficit limit and then negotiate will be high (Casella, 1999). Moreover, in the current version of the Stability Pact, penalties for countries violating their deficit ceiling are not automatic, and it is hard to escape the impression that compliance with the Pact may not be enforced. In general, the aggregate cost of compliance is minimized when marginal costs are equal across sources. However, in the Stability Pact, these marginal costs are not equalized thus inducing high compliance costs.

6.5.2.11. Conclusion

From this analysis, two main conclusions can be drawn. First, an important characteristic of the Stability and Growth Pact is its simplicity. On the one hand, fiscal rules need to be sufficiently sophisticated to find political support. On the other hand, simplicity and clarity decrease public support and financial market monitoring costs. Furthermore, the scope for discretion and disagreement amongst policy makers undermines their enforceability and credibility. In case of the Stability Pact, enforcement is weak however inducing high enforcement costs. Sanctions are not automatic and not implemented in a strict manner.

Secondly, although set-up costs are relatively low because responsibilities are taken up by existing institutions, operational costs are substantial. The Stability Pact requires several complex tasks, such as monitoring deficits, checking compliance and making reports and recommendations in case of excessive deficit which, in turn, are likely to induce substantial delay costs.

6.5.3. Tradable deficit rights

A market for tradable deficit rights can be an efficient mechanism for the implementation of fiscal constraints in the European Monetary Union. Along with well-known advantages of a market-based approach – flexibility, lower aggregate compliance costs and incentive for above minimum fiscal behavior – we will analyze whether TDR also entail lower transaction costs than the regulation approach of the Stability Pact.

6.5.3.1. Legislative costs

Tradable deficit permits must be acceptable to two types of agents, the ECB and the national governments. The governments will agree if they gain more freedom of choice regarding their fiscal policies. The ECB will agree if tradable deficit permits do not have expansionary effects on monetary targets. If these conditions are fulfilled, lobbying costs can be kept low (Bizer, Rahahleh and Sesselmeier, 2004).

Furthermore, elections matter when choosing a certain fiscal policy. In essence, the predictions of the theoretical literature on fiscal behaviour in relation to elections can be summarized as follows (Buti and van den Noord, 2004, p. 27):

1. Opportunistic behaviour implies fiscal policy manipulations before the elections;
2. Uncertainty about the electoral outcome and the degree of polarisation induce governments to undertake short-sighted policies;
3. Most models predict tax cuts before elections while the implications for spending is less clear-cut; and
4. Electoral rules shape fiscal behaviour.

The results of Buti and van den Noord (2004) can be interpreted as follows: in election off-years governments may want to build up a "war chest" which shows up as tight fiscal policy, and then go into the election year with a subsequent easing of fiscal policy. Furthermore, results show that deviations from the target (3% rule) appear larger and more systematic in election years. Consequently, governments are expected to be in favour of TDR because it offers them a larger margin in fiscal policy in election years.

Controversies about the Stability Pact began as soon as it was agreed upon, and they have not ended (Coeuré and Pisani-Ferry, 2003, p. 4). There exists no disagreement on the need for fiscal discipline in a monetary union. It is generally recognised that the Pact has helped containing the rise of deficits so typical for the preceding decade. The question is thus not whether there is a need for a Stability Pact, but whether the design of the current Pact provides the appropriate incentives for national governments and achieves the right mix between short-term flexibility and long-term constraint. A growing literature is developing on how to change the Stability and Growth Pact. Proposals have come first from academia, but increasingly also from official sides (e.g. Commission and Member States). The points-of-view can be classified into the four following categories (Coeuré and Pisani-Ferry, 2003, p. 7-8):

1. Those who recognise the imperfections of the Pact but attribute the current problems to the lack of efforts made by Member Countries. Because of the transaction costs of a new system, they favour a status-quo. These interest groups are expected to lobby in favour of the Stability Pact.
2. Those with a deep scepticism towards the effectiveness of peer pressure want to depoliticise the Pact by moving away from the rules-based system towards institution-based discipline. Those groups are likely to lobby in favour of a tradable deficit rights system.
3. Those who want to keep the general framework of a rules-based arrangement but find the current surveillance based on deficits economically irrelevant. They favour a system more related to the level of debts, or, more generally, to the sustainability of public finances. They are expected to lobby in favour of TDR which are linked to public debt.

4. Those who want to keep the rules of the current Stability Pact but soften the interpretation while avoiding the transaction costs of changing the legal framework. These interest groups are expected to lobby in favour of the Stability Pact.

Among the different Member States, only France, Germany, Greece and The Netherlands are exceeding the 3% deficit spending rule. Consequently, they have lobbied hard to get more flexibility into the Stability Pact and are expected to prefer a tradable deficit rights system above the current regulation. Smaller countries such as Austria and Luxemburg have been pushing to uphold the principles of fiscal discipline and can be expected to prefer the current regime. However, in the case of TDR, fiscal discipline in the Eurozone is also kept but more flexibility is granted at the individual Member States.

Opponents of TDR will argue that if countries keep a balanced budget over the business cycle, they will have enough flexibility during a recession allowing them to let the budget deficit increase up to 3%. According to them, this should be sufficient for most countries to follow an anti-cyclical budgetary policy during most recessions (De Grauwe, 2003).
Woerdman (2002, p. 97) states that legislative costs will be lowered when societal actors representing vested interests reduce or cease their lobbying efforts in defence of the dominant institution. More specifically, interest groups will put less time and money in lobbying if they can be convinced that they will loose the battle and that the adoption and implementation of the new instrument, namely tradable deficit permits, is inevitable. The extent to which this belief can be fed also depends on the presence, number, stake and lobbying efforts of actors representing new interests that plead for deficit permits.

According to North (1990), institutions shape human interaction by means of formal constraints, such as legal rules, and informational constraints, such as cultural values. Woerdman (2002) has analyzed whether legal barriers, that are unique for permit trading, could hinder its implementation, add to the legislative costs of this instrument and contribute to the institutional lock-in situation[222]. He states that although all permit allocation options have similar efficiency consequences; permit allocation is the most important political barrier to implementing permit trading. However, in

[222] Lock-in theory originally stems from the (economic) literature on technological change. Whereas the traditional models in this particular field of science predict that an optimal design will win, lock-in theorists identify path-dependent developments and positive feedbacks to explain why in practice often a sub-optimal technology is implemented and used for some period (Woerdman, 2002, p. 62). North (1990) came up with the idea to apply the lock-in concept to explain (a lack of) institutional change. In general, a lock-in can be defined as the dominance of a sub-optimal situation in the presence of a superior alternative. Optimality is defined in terms of efficiency and/or effectiveness.

case of TDR, the legal barrier costs will be kept low. The reason is that tradable deficit rights will be implemented on a European scale and the decision will be made by the European Commission itself. Consequently, trading deficit rights will not be seen as state aid following EC Article 87 because all Member States will participate and hence will not receive an advantage that can possibly distort competition[223]. Tradable deficit permits can thus be declared compatible with existing law[224].

In conclusion, lobbying costs of opponents of a balanced budget policy will be high. Legal barriers costs will be minimal because TDR are implemented for all Member States, which will neutralise the danger of violating EC Article 87 on state aid.

6.5.3.2. Delay costs

In the setting of TDR, delay costs will be minimal. Once non-compliance is determined, penalties will be levied with a minimal time lapse between the violation and the sanction. Furthermore, to the extent that governments need TDR to borrow money, delay costs are zero when they do not dispose of a sufficient amount of TDR. It is highly likely that the commitment of the Member States increases when the monetary system is more transparent, allows the cyclical flexibility of the national budgetary policy and can be adjusted to the demographic and financial situation of a country. The yearly settlement of the permit account also significantly reduces delay costs. Member States need to present each year their TDR to cover their deficit spending. Consequently, fewer conflicts are expected when implementing TDR in comparison with the Stability Pact which, in turn, decreases delay costs.

6.5.3.3. Information costs

Information costs comprise the costs of setting the cap and determining the amount of permits each Member State receives. In terms of deficit, the stated goal (cap) and the initial distribution are easy to quantify: 3 % of GDP. No other estimations than GDP's are necessary. Since these data are already kept, they entail few information costs. In general, good rules are simple and easily verifiable while complex rules are likely to add noise and uncertainty to the system. The current 3% rule scores well on simplicity. However, when the cap is determined in terms of its effect, for example

[223] Article 87(1) on state aid as formulated in the EC Treaty determines that '(…) any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favoring certain undertakings or the production of certain goods shall, in so far as it affects trade between Member States, be incompatible with the common market'.

[224] In practice, changing (ether the design of the deficit permit system or) the law may be a politically difficult or even undesirable exercise, which largely depends on the distribution of values and interests (Woerdman, 2002, p. 96).

upward pressure on interest rate, the system would be more effective but information costs would rise as well.

6.5.3.4. Search (planning) costs

A cap-and-trade program entails several planning issues such as geographical area, temporal flexibility and the nature of the permits. The geographical area is the Eurozone and currently consists of 12 countries. As already stated, this number is likely to be insufficient for an efficient and liquid market. Therefore, some form of regulation seems to be necessary. Temporal flexibility, namely banking and borrowing, will not be allowed (as described in § 6.2.3.3.). As far as the nature of the permit is concerned, the cap is defined as the amount of money that governments are allowed to borrow. Permits take the form of deficit rights.

The small geographical area may thus entail some regulatory costs, but the ban on temporal trade and the simple nature of the permit push planning costs substantially downwards.

6.5.3.5. Set-up costs

No additional agency needs to be set up to implement a TDR system in the European Union. In principle, all tasks like setting the cap, distributing the permits, regulating the market and monitoring and enforcing the permit system, can be performed by existing institutions such as the European Central Bank, the Ecofin Council and the European Commission. Set-up costs will thus be relatively low.

6.5.3.6. Operational costs

The administration costs depend on the choice of the trading system and the initial allocation (free, grandfathering, auction, updating). For the TDR system, we favour a free distribution of permits based on the 3 % rule, which minimizes the administration costs and is likely to entail the least social-political resistance. Once the cap is set, no other parameters should be considered. In some cases, an approval from the regulatory agency is needed to complete a trade. However, simple approval processes and few requirements are essential to keep operational costs low. Complex rules for governing the trading system can have a dramatic effect on transaction costs. It will not only make finding an acceptable buyer or seller more difficult, it will also create indistinctness about possible regulatory interference.

Concluding, as little interference as possible will keep operational costs down. In other words, Member States should be allowed to sell or buy deficit rights without approval processes or other requirements.

6.5.3.7. Negotiation costs

Negotiation costs are real resource costs to anyone entering into negotiations. Negotiations tend to be simple and easy when information about the threat values and the cooperative solution are public. Bargaining becomes more difficult and costly when it involves three or more parties. In the case of TDP, individual countries can freely trade permits. It will not be too costly because there are not many partners entering into the negotiations. Negotiating costs may be significant in the set-up phase. But as soon as market prices are determined, they will tend to drop rapidly. The European Central Bank can play an important role in negotiation costs. It can act as a broker and facilitate cooperative negotiation results between the 12 Euro-countries because of asymmetric information. It is recommended that transactions do not occur on a bilateral basis but rather pooled by the ECB.

6.5.3.8. Contract costs

The literature on transaction costs demonstrates that small numbers contracting is a source of opportunistic behaviour leading to higher contract costs (Kirkpatrick and Parker, 2004, p. 44). The result can be adverse selection which takes the form of suboptimal contracts at the outset, resulting from one of the contracting parties acting opportunistically to arrange especially favourable terms. However, in the case of TDR, the transaction costs of contracting are zero because TDR are a homogenous good and there is no time lapse between the agreement and actual transfer of the permit. In other words, transferring permits is a spot transaction of which contract costs are non-existing.

6.5.3.9. Monitoring and enforcement costs

Monitoring and enforcement are of utmost importance to realise the objectives. Casella (1999) stated that non-compliance not only negatively affects the whole Union in general, via increased interest payments, but also those countries in particular that do play by the rules. More specifically, suppose a country is in violation of the scheme. If penalties are not taken, the price of the permits could fall to zero[225]. If the trading price was positive, any country that has saved permits for sale, or that has emitted debt to finance permits purchases suffers a capital loss.

If a country is non-complying, it should face a fine for every missing permit. Member States will only constrain their behaviour if they have to bear the consequences, i.e. paying penalties. The European Central Bank should obtain the authority to monitor the market of deficit permits. While central bankers, like members of the Commission, are tenured bureaucrats without the political legitimacy that comes with elected office, they are generally

[225] Assuming that all countries are opportunistic and will not follow the rules anymore.

perceived as less politicised in the partisan sense of that world. Besides fines, also explicit political sanctions at the EU level, such as losing the right to vote on euro matters in Ecofin, might help to enforce the system.

Buiter (2003) proposes to let the National Academies of Sciences of the EMU members nominate (possibly by rotation) a group of experts to determine compliance and non-compliance of Member States. They would serve for a fixed term, without possibility of re-appointment to limit opportunistic behaviour. This could be effective if the nominees owe their allegiance first and foremost to the mandate they would hold and to the tenets of impartial scholarly judgement. However, this proposal has obvious weaknesses, most important by its high monitoring and enforcement costs.

Another possibility is to create a banking system that is legally prohibited to lend (or support the issuing of bonds) to public authorities that do not have the required deficit permits. Sanctions are then self-policing and self-enforcing and no elaborate political process à la Stability Pact is required (Collignon, 2004b). This upstream enforcing mechanism will consequently significantly reduce monitoring and enforcement costs.

Concluding, a market for deficit permits will induce lower monitoring and enforcement costs because exceptions are no longer possible and the permit price falls to zero if penalties are not executed. Transaction costs of monitoring and enforcing TDR will be lower in an upstream monitoring system (at the level of the banks) than in a downstream monitoring system (at the level of the Member States).

6.5.3.10. Compliance costs

In the simplest setting, each Member States receives each year a number of deficit permits equivalent to 3% of its GDP. At the end of every year, the Member State must have in its account a sufficient number of permits to cover that year's deficit. These used permits are withdrawn from the system. When a country is not complying, it faces a fine or has to give up a corresponding number of permits from the following year's quota. Consequently, in a market for deficit permits the transaction costs of compliance would be lower and the circumstances meriting exceptions would be harder to claim.

6.5.3.11. Conclusions

The first conclusion that can be drawn from the previous analysis relates to the transparency of the system. Clear and transparent rules will significantly reduce delay, operational, monitoring and enforcement costs. Delay costs will also be reduced because of a stronger commitment of the Member States which results in fewer conflicts. Operational costs are reduced significantly if deficit rights are freely distributed which makes the system

easy to administer and comprehensive for all Member States. Finally, monitoring and enforcement costs will be reduced in case of a upstream monitoring system, meaning at the level of the banks.

Secondly, because no additional agencies need to be created, set-up costs will be low. Existing institutions such as the European Central Bank can play an important role in minimizing transaction costs. Because of the small number of partners, price negotiation costs can be substantial. Using the ECB as an intermediate is likely to reduce asymmetric information and market dominance. Therefore, expanding the role of existing institutions is an indispensable factor in minimizing transaction costs as a whole.

6.5.4. Transaction cost comparison

In the first part of this chapter, we have already demonstrated that the Stability Pact has several disadvantages which can be overcome by using a tradable deficit rights system. However, a major concern is whether such a system does not entail prohibitively high transaction costs. The real question, however, is whether the transaction costs generated by a TDR system are significantly higher than costs induced by regulation (Stability Pact). To answer this question, we will compare the transaction costs incurred by both systems.

6.5.4.1. Information and search costs

The information and search costs of the Stability Pact and the efficacy of the instrument increase with the degree of differentiation of the rules. The current 'one size fits all' rule induces relatively low information and search costs. However, for a more efficient rule, which takes into account all the differences between the Member States, information costs will be much higher. With tradable deficit permits, simple rules will keep information costs low. As the Stability Pact, these costs will rise when the cap is differentiated, for example, determined in terms of upward pressure on interest rate. Finally, search costs of a TDR system are dependent on the geographical area, temporal flexibility and the nature of the permits. While the small geographical are may entail high search costs, these costs will be substantially lowered by the ban on temporal flexibility and the well-defined nature of the permit.

6.5.4.2. Monitoring, enforcement, compliance and delay costs

Monitoring, enforcement, compliance and delay costs are all dependent on the complexity of the rules and the transparency of the system. The excessive deficit procedure of the Stability Pact creates high delay costs because of the lengthiness of the procedure and the predetermined procedural rules that need to be followed. However, sanctions arrive not only too late; it is often the case that they do not arrive at all. Monitoring and enforcement costs are thus substantially high, mainly because of the

complicated mechanism of sanctions, the limited enforceability and the non-transparent negotiation process. The 'soft' law approach also increases compliance costs, because rules are not consistently enforced and consequently provide little incentive to comply.

While a lengthy and complex procedure lies at the bottom of the Stability Pact, thus inducing high costs, a TDR is basically self-enforcing. Delay, monitoring, enforcement and compliance costs are kept low in an upstream system, if the banks are legally prohibited to lend to public authorities that do not have the required deficit permits.

6.5.4.3. Negotiation costs

The excessive deficit procedure not only induces high delay costs, also negotiation costs are substantial because of the lengthy deliberations that can take place. Furthermore, renegotiation costs can be substantial because of the opportunistic behaviour. In case of TDR, the European Central Bank can act as a regulator to lower negotiation costs by facilitating negotiation processes between the Euro countries.

6.5.4.4. Administrative costs

TDR as well as the Stability Pact can be administered by existing institutions. Set-up costs are thus comparable for both instruments. Because of the free distribution, TDR will also entail low operational costs. These costs can be further reduced in case of simple and few approval processes. In other words, Member States should be allowed to sell or buy deficit rights without approval processes or other requirements. However, complex procedures in case of the Stability Pact will cause substantial operational costs. Whereas set-up costs are low because the Stability Pact was incorporated into existing institutions, the costs of directly administrating the regulatory system are certainly not negligible. Again, the complexity of the procedure with various tasks for different regulatory bodies, such as monitoring budgetary developments and debts, checking compliance, preparing reports and formulating recommendations, are at the basis of the high administrative costs.

6.5.4.5. Legislative costs

Lobbying costs will be substantial in both cases and is, therefore, no good criterion to choose between both approaches. It is expected that countries with a high deficit will lobby in favour of TDR while Member States who have kept their deficit within limits will prefer the current Stability Pact.

6.5.4.6. Conclusion

All results are summarized in the table 24. It can be inferred that the current Stability Pact gives rise to higher transaction costs, largely because of the complex design and procedures in case of excessive deficit. As in the case

of environmental taxation versus tradable emission rights, it all comes down to the appropriate design of the policy instrument. Whereas the current Stability Pact is designed in such a way that operational, negotiation, monitoring, enforcement and compliance costs are high, a well-designed permit trading system is likely to generate fewer transaction costs (see Table 25).

Table 24: Comparative transaction costs of regulation versus tradable deficit rights

Transaction costs	F*/V°	Regulation: Stability Pact	Tradable deficit rights
Lobbying costs	F	**High** (politicians: complex design)	**High** (opponents of balanced budget)
Delay costs	V	**High** (lengthy excessive deficit procedure)	**Low** (yearly settlement of the permit account)
Information costs	F	**High** (optimal regulation, hard law) **Low** (second best regulation, soft law)	**High** (cap in terms of its effect) **Low** (3% cap)
Search (planning) costs	F	**High** (optimal constraint) **Low** (low efficacy)	**High** (additional regulation because of few participants)
Set-up costs	F	**Low** (existing institutions)	**Low** (existing institutions)
Operational costs	V	**High** (several tasks and complex procedure)	**Low** (free distribution)
Negotiation costs	F	**High** (lengthy deliberations)	**Low** (ECB as regulator)
Contract costs	F	**Zero**	**Zero**
Monitoring and enforcement costs	V	**High** (complex rules, no automatic sanctions)	**Low** (transparent upstream system, self-enforcing)
Compliance costs	V	**High** (arbitrariness)	**Low** (no exceptions)

* = fixed / ° = variable

6.5.5. Policy implications

The main advantages of a tradable deficit rights system are its efficacy and flexibility. By setting a cap, the system makes sure that the overall goal can be attained while allowing individual discretion. Member States can meet their obligation by complying with their quota or by buying additional TDR. Since some Member States can reduce deficit spending at lower costs than others, the latter will choose to buy deficit rights from the former.

Because regulation is incorporated in current policy and the use of tradable permits is rather new, especially in fiscal issues, policy makers tend to believe that the implementation of regulation is less complicated and induces fewer transaction costs. The comparative analysis of transaction costs presented in this paragraph has shown the inaccuracy of this argument.

In the following table, we will summarize transaction costs of effective regulation (revised Stability Pact where an optimal constraint is put on Member States) and tradable deficit permits.

Table 25: Transaction effective fiscal policy instruments

Transaction costs	F*/V°	Regulation: Stability Pact	Tradable deficit rights
Lobbying costs	F	**High** (politicians: complex design)	**High** (opponents: balanced budget)
Delay costs	V	**High** (lengthy excessive deficit procedure)	**Low** (transparent system)
Information costs	F	**High** ("hard" law)	**High** (cap in term of its effect)
Search (planning) costs	F	**High** (optimal constraint)	**High** (additional regulation)
Set-up costs	F	**Low** (existing institutions)	**Low** (existing institutions)
Operational costs	V	**High** (complex)	**Low** (free distribution)
Negotiation costs	F	**High** (lengthy deliberations)	**Low** (ECB as regulator)
Monitoring and enforcement costs	V	**High** (complex)	**Low** (self-enforcing)
Compliance costs	V	**High** (arbitrariness)	**Low** (no exceptions)
Total costs		**High fixed** costs (except for set-up costs) and **high variable** costs	**High fixed** costs (except for set-up and negotiation costs) but **low variable** costs

This table reveals that, from a transaction cost perspective, the effective tradable deficit permit system is an upstream self-enforcing system in which existing institutions are used which determine the cap in term of its effect and distribute permits for free. The table also shows that effective regulation entails higher variable costs, namely delay, operational, compliance, monitoring and enforcement costs, than an effective tradable deficit rights system. Information costs of both 'effective' policy instruments will be high because the 'one size fits all' can no longer be maintained and the cap needs to be defined in terms of its effect.

7. Conclusion

7.1. Introduction

In this final chapter, the main results and conclusions of the research conducted in this study are recapitulated. First, the scientific and policy relevance of the research is discussed. Next, a summary of the results and conclusions of the design issues and comparative transaction cost analysis are provided. Finally, several concluding remarks and directions for further research on the subject of tradable permits and transaction costs are described.

7.2. Scientific and policy relevance

Cap-and-trade permit trading refers to a policy approach in which the use of a resource is capped, permits are allocated and a permit trading mechanism is established. Neo-classical economic theory considers permit trading to be efficient and effective in comparison with other policy instruments. Permit trading is efficient: marginal abatement costs are equalized across firms and every unit of the capped resource will have a price, since each unit has the opportunity of being sold. Permit trading is also effective: when the economy grows, the demand for permits rises, but their supply remains constant as a result of the cap. The government will meet its target and the scarcity of the resource will be reflected in a higher price. The implementation of the Acid Rain Program in the United States, where SO_2 emission rights are traded between electrical utility units, and the international adoption of the Kyoto Mechanisms, with IET as the most important mechanism, has put this formerly theoretical concept into practice.

It is clear that permit trading ranks first in what might be called the 'economic hierarchy' of policy instruments. Neo-classical economic theory would then expect that decision-makers choose this optimal design. However, it is a well-known phenomenon that this has not been the case. Politicians have mainly favoured sub-optimal policy instruments. The reason is that, when governments have accepted market-based solutions and decide to use permit trading as an alternative, it still has to be effectively implemented (Woerdman, 2002, p. 14-15). Prior to the establishment of a tradable permits system, policymakers must set the cap, assign initial allowances, set the rules for transfers and monitor and enforce the activities that ensue. In this book, we pay specific attention to this complex task of designing a system, initially distributing the permits, determining the transferability rules, the temporal dimension, geographical area and the indispensable monitoring and enforcement system by closely studying the already existing cap-and-trade systems in the United States. Based on these systems, we propose specific designs for the introduction of tradable transportation rights and tradable fiscal deficit rights.

However, besides the design issues, various other barriers hinder the implementation of permit trading, including institutional problems, legal

constraints and cultural objections (Woerdman, 2002, p. 470). Furthermore, permit trading is thought to have higher transaction costs than other policy approaches, such as taxes and regulation. While the literature on environmental economics has been discussing transaction costs of tradable permit systems (e.g. Stavins (1995), Woerdman (2001)), a comparative analysis of the transaction costs incurred by policy instruments across all stages of the policy process is still lacking (Krutilla, 1999). This book carries out such research. The objective of this book is to identify and assess the transaction costs generated by permit trading in three case studies, namely emission rights, entry rights and deficit rights, and compare them with other policy instruments, namely environmental taxation, road pricing and regulation.

Not only our topic and approach are relevant, but we have also taken the first steps to develop an innovative theoretical framework. Rather than focusing on terms like political 'acceptability' or 'feasibility', as most analysis of economic instruments for different policy areas have done in the past (e.g. Mullins and Baron, 1997; Koutstaal and Nentjes, 1995), we focus on transaction costs. The reason for this is that transaction costs may inhibit trade and therefore may reduce the extent to which potential savings are realized in practice. Although it is suggested that permit trading still has a long way to go before being effective in any sense because of excessive transaction costs (Rao, 2003), there exists no empirical evidence that transaction costs have prevented trade or significantly affected prices of permits in the United States (Michaelowa et al., 2003). Consequently, a comparative transaction cost analysis between tradable permits and other policy instruments deserves priority in research. We have taken up this challenge in this book by making some first moves to develop this comparative analysis in three different policy areas.

7.3. Design issues of tradable permits

Like most literature on emissions trading, we have discussed the various design elements that are of importance when introducing a system of tradable permits. Firstly, the initial distribution of the permits is one of the most complex issues in the design of a cap-and-trade system. The two most important permit allocation methods are: sources have to buy the permits (auctioning) or they get them for free (grandfathering). In the U.S. Acid Rain Program, the basic structure of the tradable permit regime is built around an annual distribution of tradable emissions allowances mainly on a grandfathered basis, together with a small auction of about 2.8% of the cap. In the RECLAIM program of California, allocations are solely based on sources' past level of activity. In the case of tradable entry permits, we have proposed a free allocation to citizens primarily for reasons of fairness and legitimacy. Using this method, one of the major sources of social opposition against road pricing, namely its redistributive impacts, could to a considerable extent be overcome (Verhoef, Nijkamp and Rietveld, 1997, p. 539). Also tradable deficit rights are proposed to be allocated for free mainly because Member States are now also entitled to run a deficit of 3 % of their GDP.

Secondly, restrictions on trade reduce the efficiency of the system and should therefore be limited. However, one of the most important fears that is expressed in almost any discussion of tradable permits involves the degree of market power that can be facilitated by the tradability. Tietenberg (2001b) supports the notion that market power on the seller side is a more serious problem than market power on the buyer side because transaction costs of forming a cartel with a large number of small sources are significantly greater than those of forming one with a small number of large sources. Although the possibility for market power is significantly small in case of entry permits, primarily because the large number of individual car users, we have demonstrated that tradable deficit rights may suffer from a market power problem. Currently, there are only 12 market players and it seems unrealistic to assume that the market will be a competitive one without some form of regulation. Furthermore, political power and asymmetric information can influence prices and bargaining processes between Member States. Consequently, we have proposed to use a regulator, preferably the European Central Bank.

Thirdly, standard theory suggests that a value maximizing tradable permit system must have temporal exchangeability, thus implying that allowances can be both borrowed and banked (Tietenberg, 2001a). However, in practice, and more specifically in the RECLAIM program, there exists no possibility for inter-temporal trade through banking or borrowing. The U.S. Acid Rain Program does allow for permits to be banked and used in the subsequent year (borrowing is also not allowed). This opportunity has played a significant role in reducing compliance costs because it enables firms the flexibility to plan their investment activities. In our design of tradable entry permits and tradable deficit rights, banking and borrowing was not allowed. The primary reason is that banking can create a temporal clustering of road use or deficit spending. Borrowing puts the cap at risk because participants can keep on borrowing permits without ever reaching their limit.

Finally, the attainment of economic, social and environmental objectives is mostly dependent on the monitoring and enforcement issues. A downstream permit trading scheme that directly includes both large and small sources is most efficient, but it also entails high administrative costs to monitor many traders. In practice, every monitoring system must identify both the information that is needed to monitor the operation of the tradable permit program and the management component that will gather, interpret, and act on this information. Effective monitoring systems are therefore composed of data, data management, and verification components. Technology plays a significant role in monitoring systems of tradable entry rights. Permits will be put on so-called smart cards that are fraud-resistant and allow easy and inexpensive transactions. Monitoring tradable deficit permit systems requires a technical ability of all governments and the European Central Bank to monitor and control the evolution of the budgets. Naturally, this requires that identical and appropriate accounting standards are utilised across all governments involved. With regard to a successful enforcement program, we have argued that a carefully constructed set of sanctions for non-compliance is necessary. In practice, predetermined fines will be imposed by the enforcing agency itself for “routine” non-compliance. We

have argued that the non-enforceability of the current Stability Pact is a serious lack. A tradable deficit permit system will also not be successful if it can not be enforced properly. Consequently, non-compliance should trigger sanctions and these sanctions can be administrative or political. For example, it is possible to suspend rights of the governments or create an upstream monitoring and enforcement mechanism at the level of the banks.

7.4. Comparative transaction cost analysis

The survival of sub-optimal policy instruments could not be explained by neo-classical economic theory, which would expect that decision-makers choose the superior alternative of permit trading. A direction to search for an explanation can be provided by transaction cost economics which was introduced by Coase (1937) to explain why firms exist as an alternative for organizing economic activity by means of exchange transactions across the market. Transaction cost reasoning became most widely known by Williamson (1979) who argued that the alternative with the lowest transaction costs in the market will survive. We have criticized and nuanced the traditional explanation of choosing sub-optimal policy instruments in three ways. First, we have developed a transaction cost taxonomy that will be helpful in improving policy design and management. Second, we have analyzed the transaction costs of permit trading in three policy areas and those of alternative policy instruments. More specifically, we have compared tradable emission rights with environmental taxes, tradable entry rights with road pricing and finally, tradable fiscal deficit rights with the current regulation, namely the Stability Pact. Third, we have presented an overview of our transaction costs analysis and expanded this theoretical analysis with policy recommendations. Also transaction costs of effective environmental and transport market-based policy instruments and of effective fiscal policy instruments are compared.
Transaction cost is now a generic term referring to any costs that come from realizing a transaction across a market. Since different types of costs may be born by different players at different points in the policy process, a proper classification of transaction cost categories is important to assure that all relevant costs are accounted for. We have extended the taxonomy proposed by Furutbotn and Richter (1997) which is the most complete to be found in the literature. They distinguish market, managerial and political transaction costs. Market transaction costs are the costs of transferring property (of user) rights between parties in a market. These costs include information costs, search costs, signalling costs, negotiation costs, contract costs and insurance costs. Managerial transaction costs are the costs of exercising the right to give orders within the organization and include set-up costs, monitoring costs, enforcement costs and bonding costs. Finally, political costs are the costs of running and adjusting a political system and comprise of lobbying costs, public support costs, enacting costs, operational costs, compliance costs and delay costs.

Tradable emission rights versus environmental taxes

From an ecological and economic perspective, it is clear that tradable emission rights outperform environmental taxes, but the crux of the former

system seems the transaction costs it entails. However, corrective taxation is itself not costless. First of all, the transaction costs of environmental taxation are conditional upon the selected tax base. The more accurately the tax base is defined, the higher the information costs and subsequent monitoring, enforcement and compliance costs. Secondly, we have shown that there appears to be a trade-off between transaction costs and the efficacy of environmental taxes. Corrective taxation, though desirable in principle, may entail prohibitively high transaction costs that can only be reduced to some extent by sacrificing its original goal, namely matching private and social costs. Tradable emission rights are mostly introduced because of two main reasons: to effectively cap environmental harm and efficiently internalize the environmental costs by setting the right price for the permits. However, the latter aim can be impaired in part by the prevalence of high transaction costs. We have analysed whether transaction costs greatly reduce the benefits of an emission trading system. In this analysis, we have shown that, contrary to popular belief, set-up costs are relatively low and not a major impediment for the implementation of a tradable permit system. The amount of transaction costs incurred is largely determined by the design of the system, in particular the distribution and trading regime. Permit trading also creates a trade-off between some cost categories. While an upstream system saves monitoring costs, it may add to negotiation costs because the market is less atomistic.

Our conclusion is that tradable emission permits can give rise to significant transaction costs, but so may environmental taxes. While the former provoke more set-up costs, the latter is burdened by information costs. Essentially, it all comes down to the appropriate design of the policy instrument. We have shown that, from a transaction cost perspective, the optimal tradable permit system is a large scale, upstream operation in which the environmental agency distributes the permits for free at the beginning of each year and ensures that excess permits can be sold via a brokered market or auction. We have also shown that user charges, indirect tax differentiation for environmentally friendly products and income tax deductibles for environmentally friendly behaviour entails the least transaction costs, yet more than the optimal tradable permit system. Moreover, these instruments are hardly as effective. When comparing effective environmental market-based policy instruments, tradable permit systems should not be rejected ex ante based on transaction costs.

Tradable entry rights versus road pricing

Although tradable permits are effective in regulating road use, cost-effective in sense that they allow citizens to choose for the least costly means of achieving the objective and rely on the same technology that is used in existing entrance zone systems, their use in transport is still non-existing. With road pricing, transaction costs are conditional upon the physical relationship between the road charge and the external costs. The more accurate the charges, in terms of internalization of all external effects, the higher the information, search and planning costs. Technology plays also an important role in transaction costs of road pricing. While road pricing with electronic vehicle identification entails relatively high set-up costs per vehicle, operational costs, monitoring costs, enforcement costs and

compliance costs will be reduced. However, if is relied on camera technology, set-up costs per vehicle will be much lower wile here, set-up costs for gantries, operational costs, monitoring, enforcement and compliance costs will increase. In the transport sector, the great number of users constitutes an obvious obstacle to introduce tradable permit systems, since negotiation costs are assumed to appear, a priori, prohibitive. We have examined this question by discussing all relevant transaction costs associated with tradable entry rights. We found that the amount of transaction costs is, again, largely dependent on the design of the system. Furthermore, there exists a trade-off between some cost categories. While a downstream allocation induces high planning costs, monitoring costs can be kept relatively low when using smart-cards for all vehicle users.

We have shown that developments in new technology are now decreasing transaction costs associated with implementing a network wide, fleet wide road pricing or tradable entry system. Our conclusion is that information costs are a decisive factor in choosing between both instruments. While no information is needed about price elasticities and marginal abatement costs in case of tradable permits, road pricing is only effective if there is sufficient differentiation in the road charge to induce the appropriate incentives. To conclude, the effective tradable entry permit system is a downstream operation in which the urban authority distributes the permits (on a smart card) for free and ensures that excess permits can be sold via an electronic market. Effective road pricing entails higher fixed costs, namely information, search and set-up costs, than an effective tradable entry permit system.

Tradable deficit rights versus regulation

The deficit spending of the Member States in the European Union is currently regulated by the Stability Pact. However, there are several weaknesses in the Stability Pact which are widely discussed in the literature (e.g. Beetsma and Uhlig, 1999). A rethinking of the fiscal-financial framework for the EMU is therefore necessary and urgent. One approach proposed by Casella (1999) is the introduction of tradable deficit permits. Deficits can be seen as external effects that weigh heavily on the Euro-market and affects all members of the European Union. We have examined the transaction costs of such a tradable fiscal deficit permit system and compared them with those of the current Stability Pact. Although the current Stability Pact is rather simple, enforcement costs are high because there is scope for discretion and disagreement amongst policy makers which undermines the enforceability. Furthermore, operational costs are substantial because the current Stability Pact requires several tasks in case of excessive deficit spending which are complex. In addition, delay costs are also large because of this complex procedure. A market for tradable deficit rights can be created as an efficient mechanism for the implementation of fiscal constraints in the European Monetary Union. Clear and transparent rules will induce significantly low delay costs, operational costs, monitoring costs and enforcement costs. Furthermore, set-up costs will be minimal because existing institutions such as the European Central Bank can play an important role in reducing these costs and the amount of asymmetric information.

Because regulation is incorporated in current policy and the use of tradable permits is rather new, especially in fiscal issues, policy makers tend to believe that the implementation of regulation is less complicated and induces fewer transaction costs. However, we have shown that the current Stability Pact is not only ineffective, it also gives rise to high transaction costs, mainly because of its complex design, unenforceability and lengthy procedures in case of excessive deficits of one of the Member States. In contrast, a well-designed permit trading system is likely to generate fewer transaction costs. Delay, monitoring, enforcement and compliance costs will be kept low in an upstream self-enforcing system where no exceptions on compliance are granted. We have concluded that the current Stability Pact has induces higher transaction costs, especially with regard to delay costs and enforcement costs. Effective regulation, where hard law is used and optimal constraints are put on Member States, will induce even higher transaction costs. While the current regulation and a tradable deficit rights system entails high fixed transaction costs, except for set-up costs of both instruments and negotiation costs of TDR, variable transaction costs of TDR are significantly lower than those of the Stability Pact.

General conclusion

In this book we have demonstrated that the historical view of preferring other (market-based) instruments above tradable permits because of excessive transaction costs is incorrect. The argument rests on an incomplete and inaccurate definition of transaction costs. Furthermore, we have shown that the current policy instruments used, such as environmental taxation, road pricing and the Stability Pact, induces in some cases even more transaction costs. If these instruments would be designed in such a way to be as effective and efficient as tradable permits, their transaction costs would prohibit their use.

Permit trading ranks low in the political hierarchy of most countries, but is climbing up. The Kyoto Protocol has been ratified by more than 55 % of industrialized countries and international permit trading is one of the four mechanisms of the Protocol. These actual developments have made the instrument better known and have put the effectiveness of existing policy under increasing pressure. However, the choice between other policy instruments and permit trading can only be made when case-specific factors are taken into account. We have focussed on one factor, namely transaction costs, and have demonstrated in three specific policy areas that the argument that tradable rights are effective, but entail prohibitively high transaction costs can no longer be maintained.

7.5. Discussion

The implications for tradable permit systems that follow from the conclusions and analysis in this study are closely related to the design issues employed. Tradable permits are a rather innovative instrument that is not yet widely used. The implication is that more research must be conducted to further elaborate the key concepts as well as the practical relations between

them. On a theoretical level, we have explicitly discussed all design possibilities and issues. This has led to a framework which was used to design permit systems outside the field of climate policy, namely in the road transport and public deficit area. Of course, our proposals are not the only design possibilities of tradable permit systems. In general, additional research can shed more light on the question which design of tradable transport permits or tradable deficit permits is the most feasible.

As described by Rao (2003, p. 6), transaction costs economics is an approach to the study of economic systems and organizations, the comparative merits of alternative forms of economic organization with its focus on micro-analytic and behavioural assumptions governing the statics or dynamics of economic agents and institutions, the law and economics. The importance of transaction costs was already recognized by Coase (1988) who stated that (p. 6):

> "Without the concept of transaction costs, which is largely absent from current economic theory, it is my contention that it is impossible to understand the working of the economic system, to analyze many of its problems in a useful way, or the have a basis for determining policy".

However, transaction costs economics remains a largely unexplored area of economics. Despite the voluminous literature in the new institutional economics, a theoretical consensus on what transaction costs are is still out of sight (Wang, 2003, p. 2). Given this current lack, we tried to present an exhaustive taxonomy of transaction costs. Since a general analysis of transaction costs is irrelevant for comparing policy instruments that are aimed at regulating specific external effects, case studies are generally necessary to provide the relevant data by which it is possible to conduct such an analysis. In this respect, transaction costs of alternative policy instruments in three case studies were compared based on the presented taxonomy. These comparative studies have been pursued by way of a qualitative analysis. The challenge is now to use these theories in light of empirical research and move forward with refined transaction costs analysis to conduct more informed and complete studies. By further quantitative research, additional information can be gathered on the administrative requirements of permit trading systems and the changes in relevant institutional structures that are necessary to introduce policy instruments with low transaction costs. The theoretical transaction costs approach presented in this study can serve as a starting point for such studies.

Bibliography

Arrow, K. (1969). "The Organisation of Economic Activity: Issues Pertinent to the Choice of Market versus Non-market Allocation." In: US Joint Economic Committee, *The Analysis of and Evaluation of Public Expenditure: the PPB System*, vol. 1, Washington: Government Printing Office, 59-73.

Atkinson, S. and Tietenberg, T. (1991). "Market Failure in Incentive-based Regulation: The Case of Emissions Trading." *Journal of Environmental Economics and Management*, 21(1), 17-31.

Backhaus, J. (2002). "Fiscal Sociology: What For?" *American Journal of Economics and Sociology*, 61(1), 55-77.

Bari M. (2002). "Literature Review on Market-Based Instruments." Report by the Land and Water Conservation, Australia.

Baron, D.P. (1985). "Regulation of prices and pollution under incomplete information." *Journal of Public Economics*, 28/2, 211-31.

Barzel, Y. (1997). *Economic Analysis of Property Rights*, Cambridge: Cambridge University Press.

Baumol, W.J. and Oates, W.E. (1971). "The Use of Standards and Prices for Protection of the Environment." *Swedish Journal of Economics*, 73, 42-54.

Baumol, W.J. and Oates, W.E. (1975). *The Theory of Environmental Policy*, New Jersey: Prentice-Hall Inc.

Baumol, W.J. and Oates, W.E. (1988). *The Theory of Environmental Policy*. Cambridge: Cambridge University Press.

Becker, G. (1968). "Crime and Punishment: An Economic Approach." *Journal of Political Economy*, 76, 169-217.

Becker, G.S. (1983). "A Theory of Competition among Pressure Groups for Political Influence", *Quarterly Journal of Economics*, 98, 371-400.

Beetsma, R. and Uhlig H. (1999). "An Analysis of the Stability and Growth Pact." *The Economic Journal*, 109(458), 546-571.

Begg, I., Buti, M., Enderlein, H., Pench, L.R., Schelkle, W. and Weale, M. (2004). "Reforming Fiscal Policy Co-ordination under EMU: What Should Become of the Stability and Growth Pact?", *Journal of Common Market Studies*, 42 (5), 1023-1059.

Bernheim, T. (2001). "Internationale Samenwerking en Instrumenten voor de Besluitvorming in het Klimaatbeleid." Federal Planning Bureau, Planning Paper 89, Belgium: Brussels.

Bizer, K. (1999). "Voluntary Agreements: cost-effective or smokescreen for failure?" *Environmental Economics and Policy Studies*, 2(2), 147-166.

Bizer, K., Rahahleh, H. and Sesselmeier, W. (2004). "Innovating the Stability and Growth Pact of the European Union by introducing Tradable Deficit Permits", Presented at the International Conference on Institutions and Policies for the new Europe", Slovenia, June 17-19, 2004.

Blauwens, G. (1988). *Welvaartseconomie en Kosten-Batenanalyses,* UFSIA Antwerpen: Universitaire Reeks Economie.

Blyumental, S. (2004). "The Stability and Growth Pact – An Analysis of the Pros and Cons", Master thesis, Department of Economics, University of Konstanz.

Bohm, P. and Russell, C.F. (1985), "Comparative Analysis of Alternative Policy Instruments" In: Kneese, A.V. and Sweeney, J.L. (eds.). *Handbook of Natural Resource and Energy Economics*, vol. 1, North Holland: Amsterdam, 395-455.

Bontems, P. and Bourgeon J.-M. (2001). "Optimal Environmental Taxation and Enforcement Policy." Economic Working Paper Archive, 20, French Institute for Agronomy Research (INRA) of the Economics Laboratory (ESR), Toulouse.

Bressers, H.Th.A. and Huitema, D. (2000). "What the doctor should know: politicians are special patients. The impact of the policy-making process on the design of economic instruments." In: Anderson, M.S. and Sprenger, R.-U. (eds.). *Market-based Instruments for Environmental Management,* Cheltenham/UK: Edward Elgar, 67-86.

Broer, P., Mulder, M. and Vromans M. (2002). "Economische effecten van nationale systemen van CO_2-emissiehandel: Nationale dilemma's bij een mondiaal vraagstuk.", Centraal Planbureau, document 018, Nederland: Den Haag, 85p.

Brunila, A., Buti, M. and in 't Veld, J. (2003). "Fiscal Policy in Europe: How Effective Are Automatic Stabilisers?", *Empirica,* 30, 1-24.

Buchanan, J.M. (1968). *Demand and Supply of Public Goods*, Chicago: Rand McNally & Company.

Buchanan, J.M. and Faith, R.L. (1981). "Entrepreneurship and the Internalization of Externalities", *Journal of Law and Economics*, 24, 95-111.

Buchanan, J.M. and Stubblebine, W.C. (1962). "Externality", *Economica*, 29, 371-384.

Buchanan, J.M. and Tullock, G. (1975). "Polluters' Profits and Political Response: Direct Control versus Taxes", *American Economic Review*, 65, 139-147.

Buiter, W., Corsetti, G. and Roubini, N. (1993). "Excessive deficits: sense and nonsense in the Treaty of Maastricht", *EconomicPolicy*, 8(1), 57-90.

Buiter, W.H. (2003). "How to Reform the Stability and Growth Pact", Mimeo, January 13, 2003.

Burrows, P. (1979). *The Economic Theory of Pollution Control*, Guildford: Billings and Sons Limited.

Burtraw, D. (1999). "Cost Savings, Market Performance, and Economic Benefits of the U.S. Acid Rain Program." In: Sorrell, S. and Skea, J. (eds.), *Pollution for Sale: Emissions Trading & Joint Implementation,* Cheltemham, UK: Edward Elgar Publishing, Ltd.

Burtraw, D. (2000). "Appraisal of the SO_2 Cap-and-Trade Market." In: Kosobud, R.F. (ed.), *Emissions Trading: Environmental Policy's New Approach,* New York: John Wiley and Sons, 331 p.

Burtraw, D. and Mansur, E. (1999). "The Effects of Trading and Banking in the SO2 Allowance Market." *Environmental Science and Technology,* 33(20), 3489-3494.

Burtraw, D., Krupnick, A.J., Mansur, E., Austin, D. and Farrell, D. (1997). "The Costs and Benefits of Reducing Acid Rain.", Discussion Paper 97-31-REV, Resources for the Future, Washington, D.C.

Buti, M. and van den Noord, P. (2004). "Fiscal Policy in EMU: Rules, discretion and political incentives", European Commission, Economic Papers, N° 206.

Buti, M., Franco, D. and Ongena, H. (1998). "Fiscal discipline and flexibility in EMU: the implementation of the Stability and Growth Pact", *Oxford Review of Economic Policy*, 14(3), 81-97.

Button, K. (1995). "Road Pricing as an Instrument in Traffic Management". In: Johansson, B. and Mattsson, L.-G. (eds.), *Road Pricing: Theory, Empirical Assessment and Policy,* Dordrecht: Kluwer Academic Publishers, 35-55.

Button, K.J. and Verhoef, E.T. (eds.) (1998), *Road Pricing, Traffic Congestion and the Environment: Issues of Efficiency and Social Feasibility*, Edward Elgar: Cheltemham.

Carlson, C., Burtraw, D., Cropper, M. and Palmer K. (1998). "Sulfur Dioxide Control by Electric Utilities: What are the Gains from Trade?", Discussion Paper 98-44, Resources for the Future, Washington, D.C.

Casella, A. (1999). "Tradable Deficit Permits: Efficient Implementation of the Stability Pact in the European Monetary Union." *Economic Policy,* 29, 323-361.

Casella, A. (2001). "Market Mechanisms for Policy Decisions: Tools for the European Union." *European Economic Review,* 45, 995-1006.

Challen, R. (2000). *Institutions, Transaction Costs and Environmental Policy: Institutional Reform for Water Resources*, Cambridge (Mass.): Edward Elgar.

Chu, C.-P. and Tsai, J.-F. (2004). "Road pricing models with maintenance cost", *Transportation*, 31, 457-477.

Coase, R.H. (1937). "The Nature of the Firm." *Economica*, 4, 386-405.

Coase, R.H. (1960). "The Problem of Social Cost." *Journal of Law and Economics*, 3, 1-44.

Coase, R.H. (1988). *The Firm, the Market and the Law*, Chicago and London: University of Chicago Press.

Coeuré, B. and Pisani-Ferry, J. (2003). "A sustainability Pact for the Eurozone", Presented at the HM Treasury's Keynes Seminar, January 2003.

Colby, B.G. (2000). "Cap-and-Trade Policy Challenges: A Tale of Three Markets." *Land Economics*, 76(4), 638-658.

Collignon, S. (2004). "The End of the Stability and Growth Pact?" *International Economics and Economic Policy*, 1(1), 15-19.

Collignon, S. (2004b). "Fiscal Policy and Democracy in Europe", Proceedings of the OeNB Workshop: A Constitutional Treaty for an Enlarged Europe: Institutional and Economic Implications for Economic and Monetary Union, 4, 76-96.

COM (1995). "A Community Strategy to Reduce CO_2 emissions from Passenger Cars and Improve Fuel Economy." COM(95)689, Brussels: European Commission.

COM (1997). *Environmental taxes and charges in the single market*, Communication, COM(97)9 final, Brussels: European Commission.

COM (2000). *Green Paper on Greenhouse Gas Emissions Trading Within the European Union*, Brussels: European Commission.

Commission of the European Agency (2000). "Report of the Commission Expert Group on Transport and Environment – Group II Measures that Simultaneously Address Climate Change and Other Environmental or Other Aspects of Sustainability", Brussels: CEC.

Commission of the European Communities (1999). "Commission Recommendations of 5th February 1999 on the Reduction of CO_2 Emissions from Passenger Cars." 1999/125/EC, Brussels: CEC.

Commission of the European Communities (2000). “EU transport in Figures: Statistical Pocketbook”, Eurostat: Brussels.

Commission of the European Communities (2003). “Calculation of Indicators of Environmental Pressure Caused by Transport”, Brussels: CEC.

Crals, E. and Vereeck, L. (2003). “Property Rights in the Transport Industry: The Implementation of Tradable Fuel Permits”., Electronic Proceedings of the 2nd Annual International Conference on Social Sciences, Honolulu, Hawaii, June 12-15, 2003.

Crals, E. and Vereeck, L. (2003b). “Tradable Deficit Rights: A Proposal to Restore Sustainable Deficit Spending while Maintaining Fiscal Discipline and Monetary Stability in Europe.” In: Backhaus, J., Heijman, W., Nentjes, A. and van Ophem, J. (eds.). *Economic Policy in an Orderly Framework*, Münster: LIT Verlag, 128-142.

Crals, E. and Vereeck, L. (2004). “Environmental Taxes versus Trade in Emission Permits: A Transaction Cost Approach”, Paper presented at the 17th Workshop in Law and Economics, University of Erfurt: Germany, April 7-8.

Crals, E. and Vereeck, L. (2004b). “A Mobility Tax Deductible”. Presented at the Fourth Erfurt Conference on Fiscal Sociology, Germany: University of Erfurt, Germany, October 8, 2004.

Crals, E. and Vereeck, L. (2004c). "SME’s and Sustainable Entrepreneurship: Theory and Practice", In: Philips, C. (ed). Environmental Justice and Global Citizenship', Oxford: Inter Disciplinary Press, 37-46.

Crals, E. and Vereeck, L. (2005). “Taxes, Tradable Permits and Transaction Costs”, *European Journal of Law and Economics,* 20(2), 199-223.

Crals, E. and Vereeck, L. (2005b). “A more sustainable urban transport system: The case of tradable entry permits.” In: Brebbia, C.A. and Wadhwa, L.C. (eds.) *Urban Transport XI: Urban Transport and the Environment in the 21st Century*, Southampton: WIT Press, 301-312.

Crals, E. and Vereeck, L. (2005c). “The affordability of Sustainable Entrepreneurship Certification for SME’s”, *International Journal of Sustainable Development and World Ecology*, 12(2), 173-183.

Crals, E., Keppens, M. and Vereeck L. (2004). “Tradable Fuel Permits: Towards a Sustainable Road Transport System”, In: Haugestad, A.K. and Wulfhorst J.D. (eds.), Future as Fairness: Ecological Justice and Global Citizenship, New York: Rodopi, 121-138.

Crals, E., Keppens, M. and Vereeck, L. (2004b). “Environmental pollution and tradable transportation rights Europe.” In: Brebbia, C.A. and Wadhwa, L.C. (eds.). *Urban Transport X: Urban Transport and the Environment I the 21st Century*, Southampton UK: WIT Press.

Crals, E., Keppens, M., Macharis, C., Ramboer, R., Vereeck, L., Vleugels, I. (2005 forthcoming). "Tradable Mobility Rights: Feasibility, Socio-Economic Effectiveness and Legitimacy", CP/35, Brussels: Federal Science Policy Office, forthcoming.

Cramton, P. and Kerr, S. (1999). "The Distributional Effects of Carbon Regulation: why auctioned carbon permits are attractive and feasible", In: Sterner, T. (ed.), *The Market and the Environment*, Cheltenham, United Kingdom: Edward Elgar, Chapter 12, 255-271.

Cramton,, P. and Kerr, S. (2002). "Tradeable Carbon Permit Auctions: How and why to auction not grandfather." *Energy Policy*, 30(4), 333-345.

Crocker, T.D. (1966). "The Structuring of Atmospheric Pollution Control Systems." In: H. Wolozin (ed.), *The Economics of Air Pollution*, New York: Norton, 61-86.

Dahlman, C.J. (1979). "The Problem of Externality." *Journal of Law and Economics*, 22, 141-162.

Dales, J. (1968). *Pollution, Property and Prices*, Toronto: University Press.

Dayomi, A.M. (2000). "The automobile as a pollutant", In: Diaz, C., Gonzalez, P. and Jamet, C. (eds.). *Urban Transportation and Environment*, A.A. Balkema Publishers, 3-8.

De Borger, B., Peirson, J. and Vickerman, R. (2001). "An overview of policy instruments", In: De Borger, B. and Proost, S. (eds.). *Reforming Transport Pricing in the European Union: A Modelling Approach,* Cheltenham / UK: Edward Elgar.

De Grauwe, P. (2003). "The Stability and Growth Pact in need of reform", Working Paper, University of Leuven.

de Jong, G. and Gunn, H. (2001). "Recent evidence on car cost and time elasticities of travel demand in Europe." *Journal of Transport Economics and Policy*, 35, 137-160.

De Standaard (2005). "Europa kan Antwerps mobiliteitsplan doorkruisen", Vlaamse uitgeversmaatschappij n.v., 19/04/2005.

Demsetz, H. (1997), "The Firm in Economic Theory: A Quiet Revolution", *American Economic Review*, 87(2), 426-429.

Dewees, D.N. (1983). "Instrument Choice in Environmental Policy", *Economic Inquiry*, 21, 53-71.

Dinan, T. and Rogers, D.L. (2002). "Distributional Effects of Carbon Allowance Trading: How Government Decisions Determine Winners and Losers". *National Tax Journal*, 55(2), 199-221.

Dobes, L. (1998). "Tradable permits in transport", Bureau of Transport and Communications Economics, working paper 37, Commonwealth of Australia.

Dobes, L. (1999). "Kyoto: Tradable Greenhouse Emission Permits in the Transport Sector." *Transport Reviews*, 19(1), 81-97.

Dodgson, J., Young, J. and van der Veer, J. (2002), "Paying for Road Use", Technical Report, A Report to the Commission for Integrated Transport, National Economic Research Associates (NERA), London, www.cfit.gov.uk/research/pfru/pdf/pfru-tech.pdf

Downing, P.B. and White, L.J. (1986). "Innovation in Pollution Control." *Journal of Environmental Economics and Management*, 13, 18-29.

Dudek, D.J. and Wiener, J.B. (1996). *Joint Implementation and Transaction Costs Under the Climate Change Convention*, Restricted Discussion Document ENV/EPOC/GEEI(96)1, Paris: OECD.

Dupuit, J. (1844), "On the Measurement of the Utility of Public Works", *Annales des ponts et chaussées*, 8(2), 332-375.

Eggertsson, T. (1990). *Economic Behaviour and Institutions*, Cambridge: Cambridge University Press.

Ekelenkamp, A., Hötte, M. and van der Vlies, J. (2000), "Nieuwe instrumenten voor het milieubeleid", TNO-report, STB-00-08, Delft.

Ellerman, A.D., Joskow, P.L., Schmalensee, R., Montero J.-P. and Bailey E.M .(2000). *Markets for Clean Air: The US Acid Rain Program.* Cambridge: Cambridge University Press.

Ellerman, A.D., Schmalensee, R., Jowkow, P.L., Montero J.P and Bailey, E.M. (1997). "Emissions Trading under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance." MIT Center for Energy and Environmental Policy Research.

Ermoliev, Y, Michlevich, M. and Nentjes, A. (2000). "Markets for Tradeable Emission and Ambient Permits: A Dynamic Approach." *Environmental and Resource Economics*, 15, 39-56.

European Commission (1995), "A Community Strategy to reduce CO2 Emissions from Passenger Cars and Improve Fuel Efficiency", COM(95)689, CEC: Brussels.

European Commission (2001), Voorstel van de Commissie aan de Europese Raad van Göteberg, "Duurzame Ontwikkeling in Europa voor een Betere Wereld: Een strategie van de Europese Unie voor Duurzame Ontwikkeling", COM(2001)264/2, CEC: Brussels.

European Environment Agency (2001). "TERM 2001: Indicators Tracking Transport and Environment Integration in the European Union", Copenhagen: EEA.

European Environment Agency (2002). "Greenhouse Gas Emission Trends in Europe 1990-2000, Copenhagen: EEA.

European Environment Agency (EPA) (1998). "Het milieu in Europa: de Tweede Balans", Luxemburg: OPOCE (Office for Official Publications of the European Communities).

Fatás, A., von Hagen, J., Hallett, A.H., Strauch, R.R. and Sibert, A. (2003). *Stability and Growth in Europe: Towards a Better Pact*, Monitoring European Integration 13, London: Centre for Economic Policy Research.

Federal Ministry of Economics and Labour (2004). "Information on Finance, Economic Activity and Labour in Germany", http://www.bmwa.bund.de, Berlin, 29 January 2004.

Fitoussi, J.P. (2002). "The Stability (and Growth) Pact and Monetary Policy", European Parliament, Committee for Economic and Monetary Affairs, Briefing Paper n° 4-15.

Fleming, D. (1997), "Tradable Quotas: Using Information Technology to Cap National Carbon Emissions", *European environment*, 7, 139-148.

Foster, V. and Hahn, R.W. (1993). *Emissions Trading in LA: Looking Back to the Future*, Working paper, Washington: American Enterprise Institute.

Friedman, D. (1984). "On the Efficiency of Experimental Double Auction Markets", *American Economic Review*, 74(1), 60-72.

Friedman, D. and Ostroy, J. (1995). "Competitivity in Auction Marekts: An Experimental and Theoretical Investigation", *Economic Journal*, 105, 22-53.

Fuguitt, D. and Wilcox, S. J. (1999). *Cost-Benefit Analysis for Public Sector Decision Makers*, Westport – Connecticut / London: Quorum Books.

Furubotn, E.G. and Richter R. (1997). *Institutions and Economic Theory: The Contribution of the New Institutional Economics,* Ann Arbor: University of Michigan Press.

Geldner, A. (2005). "Unabhängigkeit ist schön – beim Geldausgeben: Wirtschaftswissenschaftler ziehen eine kritische Bilanz des deutschen Föderalismus: im internationalen Vergleich starr und teuer", *Stuttgarter Zeitung*, 86.

Gentry, W.M. (1999). "Optimal Taxation", In: Cordes, J.J., Ebel, RD and Gravette, J.C. (eds.), *Encyclopaedia of Taxation and Tax Policy*, Urban Institute, 307-309.

Gielen, A.M., Koutstaal, P.R. and Vollebergh, H.R.J. (2002). "Comparing Emission Trading with Absolute and Relative Targets", Paper presented at the 2nd CATEP Workshop on the Design and Integration of National Tradable Permit Schemes for Environmental Protection, University College London, 25-26 March 2002.

Goodin, R.E. (1994). "Selling Environmental Indulgences", *Kyklos*, 47(4), 573-596.

Goodwin, P.B. (1992), "A Review of New Demand Elasticities with Reference to Short and Long Run Effects to Price Changes", *Journal of Transport Economics and Policy*, 26(2), 155-169.

Graeme, L. (2001). "More roads and road pricing- the way to go?", Policy paper, Institute of Directors, London.

Graham, D. and Glaister, S. (2002a). "The demand for automobile fuel: a survey of elasticities", *Journal of Transport Economics and Policy,* 36, 1-26.

Graham, D. and Glaister, S. (2002b). *Review of Income and Price Elasticities in the Demand for Road Traffic*, London: Department for Transport.

Hahn, R. (1984). "Market Power and Transferable Property Rights." *Quarterly Journal of Economics,* 99(4), 753-765.

Hahn, R.W. (1989). "Economic Perspectives for Environmental Problems: How the Patient Followed the Doctor's Orders." *Journal of Economic Perspectives*, 3(2), 95-114.

Hahn, R.W. (1990). "The Political Economy of Environmental Regulation: Towards a Unifying Framework." *Public Choice*, 65, 21-47.

Hahn, R.W. and Hester G.L. (1989). "Marketable Permits: Lessons for Theory and Practice." *Ecology Law Quarterly*, 16, 361-406.

Haites, E. and Mullins, F. (2001). "Linking Domestic and Industry Greenhouse Gas Emissions Trading Systems", Prepared for the EPRI (Electric Power Research Institute), International Energy Agency and International Emissions Trading Association, 85 p.

Harberger, A. (1974). *Taxation and Welfare*. Boston: Little, Brown.

Harrison, D. (1999), "Tradable Permits for Air Pollution Control: The US experience", In: OECD, *Implementing Domestic Tradable Permits for Environmental Protection*, OECD: Paris, 23-51.

Harrison, D. and Radov D.B. (2002). "Evalution of Alternative Initial Allocation Mechanisms in a European Union Greenhouse Gas Emissions Allowance Trading Scheme." National Economic Research Associates, Prepared for DG Environment, European Commission, 168 p.

Hau, T.D. (1992). "Congestion Charging Mechanisms for Roads: An Evaluation of Current Practice", Policy Research Working Papers, Washington: The World Bank.

Helfand, G.E. (1999). "Standards versus taxes in pollution control." In: Jeroen C.J.M. van den Bergh (ed.). *Handbook of Environmental and Resource Economics*. Cheltenham: Edward Elgar.

Higley, Charles J. and Lévêque, F. (ed.) (2001). "Environmental Voluntary Approaches: Research Insights for Policy-Makers", Presented at the International Policy Workshop on the Use of Voluntary Approaches at the Centre Borchette, Brussels.

HM Treasury (2004). "The Stability and Growth Pact: A Discussion Paper", www.hm-treasury.gov.uk.

Hodson, D. and Maher, I. (2001). "The Open Method as a New Mode of Governance: The Case of Soft Economic Policy Co-ordination", *Journal of Common Market Studies*, 39(4), 719-746.

ICF (1995). "Economic Analysis of Title IV Requirements of the 1990 Clean Air Act Amendments", Prepared for the U.S. Environmental Protection Agency.

ICF (Resources Incorporated) (1990). "Comparison of the Economic Impacts of the Acid Rain Provisions of the Senate Bill (S. 1630) and the House Bill (S. 1630)", Prepared for the U.S. Environmental Protection Agency, Washington D.C.

Inman, R.P. (1987). "Markets, Government, and the "New" Political Economy", In: Auerbach, A.J. and M. Feldstein (eds.), *Handbook of Public Economics*, Volume II, North-Holland: Elseviers Science Publishers BV, 647-777.

Irlenbusch, B. and Sutter M. (2000). "An Experimental Analysis of the Stability and Growth Pact in the European Monetary Union." Presented at the 20th Arne Ryde Symposium on Experimental Economics, Sweden: 9-11 November Lund University.

Jackson, T. (1995). "Joint implementation and cost-effectiveness under the framework convention on climate change." *Energy Policy,* 23(2), 117-138.

Jacquet, P. and Pisani-Ferry, J. (2001). "Economic policy co-ordination in the Eurozone: what has been achieved? What should be done?", Sussex European Institute, Working Paper No. 40.

Jochimsen, B. and Nuscheler, R. (2003). "The Political Economy of the German Länder Deficits", Discussion Paper, Social Science Research Centre Berlin, Germany.

Johansson, R.C. (2000). "Cheating on the nonpoint margin. How much might it cost?". Working Paper AAEA, Annual Meeting, July 30 - August 2, USA: Tampa, Florida.
Jones, P. (1998). "Urban Road Pricing: Public Acceptability and Barriers to Implementation." In: Button, K.J and Verhoef, E.T. (eds.). *Pricing, Traffic Congestion and the Environment*, Lincolnshire: Edward Elgar.

Jones, P.M. (1998), *Road Pricing, Traffic Congestion and the Environment: Issues of Efficiency and Social Feasiblity*, Edward Elgar: Cheltemham.

Joskow, P.J. and Schmalensee, R. (1998). "The Political Economy of Market-Based Environmental Policy: The U.S. Acid Rain Program." *Journal of Law and Economics*, 41(1), 37-83.

Joskow, P.J., Schmalensee, R. and Bailey, E.M. (1998). "The Market for Sulfur Dioxide Emissions." *American Economic Review,* 88(4), 669-685.

Kaplow, L. (1996). "How Tax Complexity and Enforcement Affect the Equity and Efficiency of the Income Tax", *National Tax Journal*, 49(1), 135-150.

Kassim, H. and Menon, A. (2004). "European Integration since the 1990s: Member States and the European Commission", Paper Presented at the ARENA seminar, University of Oslo, February 11, 2004.

Keeler, A. (1991). "Noncompliant firms in transferable discharge permit markets: Some extensions." *Journal of Environmental Economics and Management,* 21(2), 180-189.

Keppens, M. and Vereeck, L. (2004). "A review and assessment of tradable permits in road transport sector", Proceedings of the WCTR Conference, Turkey: Istanbul.

Keppens, M., Crals, E. and Vereeck, L. (2004). "New approach to reduce CO2 emissions of private road transport: A tradable permit program in Europe.", Electronic Proceedings of the 83rd Annual Meeting of the Transportation Research Board, US: Washington D.C., January 11-15, 2004.

Kirkpatrick and Parker (2004). "Infrastructure Regulation: Models for Developing Asia", ADB (Asian Development Bank) Institute, Research Paper Series No. 60.

Kitamori, K. (2002). "Domestic GHG emission trading schemes: recent developments and current status in selected OECD countries." In: OECD, *Implementing Domestic Tradeable Permits: Recent Developments and Future Challenges*, OECD Proceedings, 69-103.

Klemperer, P. (1999)."Auction Theory: A guide to the Literature", *Journal of Economic Surveys*, 13(3), 227-286.

Kling, C. and Rubin, J. (1997). "Bankable Permits for the Control of Environmental Pollution." *Journal of Public Economics*, 64(1), 99-113.

Knight, F. (1924), "Some Fallacies in the Interpretation of Social Cost", *Quaterly Journal of Economics*, 38, 582-606.

Kolstad, C.D. (2000). *Environmental Economics*, New York / Oxford: Oxford University Press.

Kolstadt, C. (1987). "Uniformity versus Differentiation in Regulating Externalities", *Journal of Environmental Economics and Management*. 14, 386-399.

Koutstaal, P. (1996), *Tradeable CO2 emission permits in Europe: A study on the design and consequences of a system of tradeable permits for reducing CO2 emissions in the European Union,* PhD Dissertation, Rijksuniversiteit Groningen.

Koutstaal, P. (2002). "Tradable permits in economic theory", In: van den Bergh, J.C.J.M. (ed.). *Handbook of Environmental and Resource Economics,* Cheltenham / UK: Edward Elgar.

Koutstaal, P. and Nentjes, A. (1995). "Tradable Carbon Permits in Europe: Feasibility and Comparison with Taxes." *Journal of Common Market Studies*. 33(2), 219-233.

Krutilla, K. (1999). "Environmental policy and transactions costs."; In Jeroen C.J.M. van den Bergh (ed.). *Handbook of Environmental and Resource Economics*. Cheltenham: Edward Elgar.

Laffont, J.J. (1988). *Fundamentals of Public Economics*, Cambridge (Mass.): MIT Press.

Lossani, M., Natale, P. and Tirelli, P. (2002). "Rethinking EMU Institutions" Working Paper 40, Department of Economics, Italy: University of Milano-Bicocca.

Lyon, R.M. (1986). "Equilibrium Properties of Auctions and Alternative Procedures for Allocation Transferable Permits." *Journal of Environmental Economics and Management*, 13(2), 129-152.

Malik, A. (1990). "Markets for pollution control when firms are noncompliant." *Journal of Environmental Economics and Management*, 18(2), 97-106.

Malik, A. (1992). "Enforcement costs and the choice of policy instruments for pollution control." *Economic Inquiry*, 30(4), 714-721.

Marcucci, E. and Marini, M. (2003). "Individual uncertainty and the political acceptability of road pricing policies". In: Schade, J. and Schlag, B. (eds.). *Acceptability of Transport Pricing Strategies,* Elsevier.

McKibben, W.J. (1998). "International Permit Trading: Creating a Sustainable System." Economics and Environment Network Working Papers, Canberra: Australian National University.
McNorran and Nellor (1994). *Tax Policy and the Environment: Theory and Practice*, Washington: International Monetary Fund.

Meyer, K.E. (2001). "Institutions, Transaction Costs, and Entry Mode Choice in Eastern Europe." *Journal of International Business Studies*, 32(2): 357-367.

Michaelowa, A. (1998). "Impact of Interest Groups on EU Climate Policy", *European Environment*, 8(5), 152-160.

Michaelowa, A. et al. (2003). "Transaction costs of the Kyoto Mechanisms." *Climate Policy*, 3, 261-278.

Milgrom, P. and Roberts, J. (1992). *Economics, Organization, and Management,* New York: Prentice-Hall.

Mishan, E.J. (1967). "Pareto Optimality and the Law", *American Economic Review*. 57, 255-287.

Mishan, E.J. (1971). "The postwar literature on externalities: an interpretative essay", *Journal of Economic Literature*, 9, 1-28.

Montero, J.-P. (2002). "Prices versus quantities with incomplete enforcement." *Journal of Public Economics,* 85(3), 435-454.

Montgomery, W.D. (1972), "Markets and Licenses and Efficient Pollution Control Programs", *Journal of Economic Theory*, 5(4), 395-418.

Mueller, D.C. (1997) (ed.). *Perspectives on Public Choice,* New York: Cambridge University Press.

Mullins, F. and Baron, R. (1997). *International GHG emission trading: Policies and Measures for Common Action*, Working Paper 9, Paris: OECD/IEA.

Muscatelli, V.A., Natale, P. and Tirelli, P. (2003). "A Simple and Flexible Alternative to the Stability and Growth Pact Deficit Ceilings. Is it at Hand?", CESifo Working paper no. 1006, Munich.

Musgrave, R.A. (1959). *The Theory of Public Finance.* New York: McGraw Hill.

Musgrave, R.A. and Peacock, A.T. (eds.) (1958). *Classics in the Theory of Public Finance*, London: Macmillan.

Nash, C. (2000). "Pricing European Transport Services", PETS? Final Report, ST 96 SC 172, project funded by the European Commission under the Transport RTD program of the 4th framework program.

Nentjes, A. and B. Dijkstra (1994), The Political Economy of Instrument Choice in Environmental Policy, in M. Faure, J. Vervaele and A. Weale (eds.), Environmental Standards in the European Union in an Interdisciplinary Framework, Maklu, Antwerpen, pp. 197-215.

Nijkamp, P. (1999). "Sustainable transport: new research and policy challenge for the next millennium", *European Review*, 7(4), 551-567.

Nijkamp, P., Rienstra, S.A., Smokers, R.T.M. and Vleugel, J.M. (2004). "Socio-economic Dynamics and Spatial Mobility: A Scenario Application to Environmental Strategies in Transport", In: Nijkamp, P. (ed.). *Environmental Economics and Evaluation: Selected Essays of Peter Nijkamp, volume 4*, Cheltemham/UK: Edward Elgar, 290-313.

Niskanen, E. (2003). "Identifying implementation paths for marginal cost pricing in urban transport and on interurban roads", Presented at the Fourth Seminar of the IMPRINT-EUROPE Thematic Network, *Implementing Pricing Policies in Transport: Phasing and Packaging*, Brussels, May 13-14.

Niskanen, W.A. (1971). *Bureaucracy and Representative Government*. Chicago: Aldine-Atherton.

Noll, R.S. (1981). "The Feasibility of Marketable Emission Permits in the United States", Social Science Working Paper 397, Pasadena: California Institute of Technology.

Norregaard, J. and Reppelin-Hill, V. (2000). "Controlling Pollution: Using Taxes and Tradable Permits", *Economic Issues*, 25, 14.

North, D.C. (1990). *Institutions, Institutional Change and Economic Performance,* Cambridge: Cambridge University Press.

Oakland, W.H. (1987). "Theory of Public Goods", In: Auerbach, A.J. and M. Feldstein (eds.), *Handbook of Public Economics,* Volume II, North-Holland: Elseviers Science Publishers BV, 485-535.

Oberholzer-Gee, F. and Weck-Hannemann, H. (2002). "Pricing road use: politico-economic and fairness considerations", *Transportation Research Part D*, 7, 357-371.

OECD (1996). *Implementing Strategies for Environmental Taxes*, Paris: OECD.

OECD (2001), *Domestic Transferable Permits for Environmental Management: Design and Implementation*, OECD Proceedings.

OECD (2001). *Transaction Costs and Multifunctionality Main Issues*, OECD Analytical Framework Guiding Policy Design, Working Paper.

OECD (2002), "Towards International Emissions Trading: Design Implications for Linkages", COM/ENV/EPOC/IEA/SLT(2002)5.

OECD (2004). "Environment and Distributional Issues: Analysis, Evidence and Policy Implications", Working Party on National Environmental Policy, ENV/EPOC/WPNEP(2003)12/FINAL.

Olson, M. (1965). *The Logic of Collective Action*. Cambridge (Mass.): Harvard University Press.

Pargal, S., and Heil, M. (2000), "Reducing Air Pollution form Urban Passenger Transport: A Framework for Policy Analysis", *Journal of Environmental Planning and Management*, 43(5), 665-688.

Parry, I.W.H. (2004). "Are Emissions Permits Regressive?", *Journal of Environmental Economics and Management*, 47(2), 364-387.

Paulus, A. (1995), *The Feasibility of Ecological Taxation*, Maastricht: Datawyse / Universitaire Pers.

Pearce, D. (1995). "Joint Implementation: a general overview." In: Jepma, C.J. (ed.), *The Feasiblity of Joint Implementation,* Dordrecht: Kluwer.

Peltzman, S. (1976). "Toward a More General Theory of Regulation", *Journal of Law and Economics*, 19, 211-240.

Pigou, A.C. (1912), *Wealth and Welfare*, London: MacMillan.
Pigou, A.C. (1920). *The Economics of Welfare*, London: MacMillan.

Rao, P.K. (2003). *The Economics of Transaction Costs: Theory, Methods and Applications*, New York: Palgrave Macmillan.

Raunio, T. and Wiberg, M. (1998). "Winners and Losers in the Council: Voting Power Consequences of EU Enlargements", *Journal of Common Market Studies*, 36(4), 549-562.

Raux, N. (2002). "The Use of Transferable Permits in the Transport Sector." In: OECD, *Implementing Domestic Tradable Permits: Recent Developments and Future Challenges*, Paris: OECD, 141-182.

Revesz, R.L. and Stavins, R.N. (2005), "Environmental Law and Policy". In: Polinsky, A.M. and Shavell, S. (eds.), *The Handbook of Law and Economics*, Amsterdam: North-Holland/Elsevier Science. forthcoming.

Richman, B.D. and Boerner, C. (2004). "A Transaction Cost Economizing Approach to Regulation: Understanding Government Responses to the NIMBY Problem", Duke Law School Legal Studies, Research Paper No. 56.

Roe, M.J. (1998). "Backlash." *Columbia Law Review*, 98(1), 217-241.

Rubin, J.D. (1996). "A Model of Intertemporal Emission Trading, Banking, and Borrowing." *Journal of Environmental Economics and Management*, 31(3), 269-286.

Rudel, R. (2003). "Fiscal Regimes and Environmental Goals in the European Transport Policy", Paper presented at the 3rd Swiss Transport Research Conference, Monte Verità, March 19-21

Samuelson, P.A. (1955). "Diagrammatic Exposition of a Theory of Public Expenditure." *Review of Economics and Statistics*, 37, 350-356.

Sandmo, A. (1975). "Optimal Taxation in the Presence of Externalities", *Swedish Journal of Economics*, 77, 86-89.

Santos, G. (2000). "On the Economic, Technological and Political Aspects of Road Pricing as a Tool for Traffic Demand Management", Proceedings of the European Transport Conference, Homerton College, Cambridge, September 11-13.

SCAQMD (1998), *Reclaim Program Three-Year Audit and Progress Report*, South Coast Air Quality Management District, http://www.aqmd.gov/hb/980539a.html

Schmalensee, R., Joskwo, P.L., Ellerman, A.D., Montero, J.P and Bailey, E.M. (1998). "An Interim Evaluation of Sulfur Dioxide Emissions Trading", *Journal of Economic Perspectives*, 12(3), 53-68.

Schneider, F. and Wagner, A.F. (2003). "Tradeable Permits – Ten key design issues", Working Paper no. 0304, University Linz, Austria.

Schneider, F. and Weck-Hannemann, H. (2003). "Why is Economic Theory Ignored in Environmental Policy Practice", Working Paper, Department of Economics, University of Linz, Austria, 20 p.

Schöb, R. (1996). "Choosing the right instrument: the role of public revenues for environmental policy", *Environmental and Resource Economics*, 8(4), 399-416.

Secretary of State for Transport (2004). "Feasiblity Study of Road Pricing in the UK.", Study Report, http://www.dft.gov.uk

Seitz, H. (2000). "Fiscal policy, deficits and politics of subnational governments: The case of the German Laender." *Public Choice*, 102, 183-218.

Shaffer, B. and Santos, G. (2003), "Preliminary results of the London Congestion Charging Scheme", Working Paper n° 04-3979, University of Cambridge.

Slemrod, J. and Sorum, N. (1984). "The Compliance Cost of the Us Individual Income Tax System", *National Tax Journal*, 37(4), 462-465.

Smith, S. (2002). "Ex-post evaluations of tradeable permit programmes." In: OECD, *Implementing Domestic Tradeable Permits: Recent Developments and Future Challenges*, OECD Proceedings, 29-66.

Smith, V.L., Williams, A.W., Bratton, W.K. and Vannoni, M.G. (1982). "Competitive Market Institutions: Double Auctions versus Sealed Bid-Offer Auctions", *American Economic Review*, 72(1), 58-77.

Soberg, M. (2000). "Price Expectations and International Quota Trading: An Experimental Evaluation", *Environmental and Resource Economics*, 17, 259-277.

Stavins, R. (1995). "Transaction costs and tradeable permits." *Journal of Environmental Economics and Management*, 29(2), 133-148.

Stavins, R. (2000). "Experience with market-based environmental policy instruments.", Resources for the Future, Washington, D.C.

Stavins, R.N. (2002). *Lessons from the American Experiment with Market-Based Environmental Policies,* Nota di Lavoro 30.2002, Milan: Fondazione Eni Enrico Mattei (FEEM).

Stigler, G.J. (1971). "The Theory of Economic Regulation", *Bell Journal of Economics and Management Science*, 2(1), 3-21.

Stranlund, J.K. and Chavez, C.A. (2000). "Effective Enforcement of a Transferable Emissions Permit System with a Self-Reporting Requirement." *Journal of Regulatory Economics*, 18(2), 113-131.

Stranlund, J.K. and Dhanda K.K. (1999). "Endogenous Monitoring and Enforcement of a Transferable Emissions Permit System." *Journal of Environmental Economics and Management*, 38(3), 267-282.

Svendsen, G.T. (1999). "Interest Groups Prefer Emission Trading: A New Perspective." *Public Choice,* 101(1-2), 109-128.

Tietenberg, T. (1985), "Emissions Trading: An exercise in reforming pollution policy", Resources for the Future: Washington.

Tietenberg, T. (1998). "Tradable Permits and the Control of Air Pollution in the United States." *Zeitschrift Für Angewandte Umweltforschung*, Sonderheft, 9, 11-31.

Tietenberg, T. (1999). "Lessons from using transferable permits to control air pollution in the United States." In: van den Bergh, J.C.J.M. (ed.), *Handbook of Environmental and Resource Economics,* Cheltenham: Edward Elgar, 275-292.

Tietenberg, T. (2000). *Environmental and Natural Resource Economics,* Addison Wesley Longman, Inc.

Tietenberg, T., Grubb M., Michaelowa, A., Swift, B. and Zhang Z.X. (1999). *International Rules for Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting and Accountability,* UNCTAD/GDS/GFSB/Misc.6, Geneva: United Nations Conference on Trade and Development (UNCTAD).

Tietenberg, T.H. (1999a). "Tradable Permit Approaches to Pollution Control: Faustian Bargain or Paradise Regained?" In: Kaplowitz, M.D. (ed.) *Property Rights, Economics, and The Environment*, Stamford, CT: JAI Press Inc., 175-199.

Tietenberg, T.H. (1999b). "Design Issues Seeking Research Answers". Presented at the Conference on Research Frontiers in GHG Emissions Trading, Resources for the Future, Inc., Washington, D.C.

Tietenberg, T.H. (2001a). "The Tradable Permits Approach to Protecting the Commons: What Have We Learned?" In: Ostrom, E. et al. (eds.) *The Drama of The Commons*, National Research Council: Committee on the Human Dimension of Global Change, Washington: National Academy Press, 197-232.

Tietenberg, T.H. (2001b). "Editor's introduction in The Evolution of Emissions Trading: Theoretical Foundations and Design Considerations", In: Tietenberg, T.H. (ed.), *Emissions Trading Programs*, Volume I and II, Aldershort, UK: Ashgate.

Trace (1998). *Review of Existing Evidence on Time and Cost Elasticities of Travel Demand and on the Value of Travel Time*, The Hague: TRACE Consortium.

Van Horn Consulting, Energy Ventures Analysis, Inc. and White, K.D. (1993). "Integrated Analysis of Fuel, Technology and Emission Allowance Markets", Prepared for the Electric Power Research Institute (EPRI), EPRI TR-102510.

Verde, A. (2004). "The Stability and Growth Pact in Rainy Days: An Alternative View", *Bank of Valletta Review*, 30, 14-31.

Verhoef, E. (1996). *The Economics of Regulating Road Transport*, Cheltemham, U.K./Brookfield, U.S: Edward Elgar.

Verhoef, E., Nijkamp, P. and Rietveld, P. (1997). "Tradable Permits: Their Potential in the Regulation of Road Transport Externalities", *Environment and Planning B: Planning and Design*, 24, 527-548.

Verhoef, E.T. (1999). "Externalities", In: van den Bergh J.C.J.M. (ed.), *Handbook of Environmental and Resource Economics*, Cheltemham, UK / Northampton, MA, USA: Edward Elgar, 197-214.

von Hagen, J. and Strauch, R.R. (2001). "German Public Finances: Recent experiences and Future Challenges", Working Paper B13, Center for European Integration Studies, Germany.

Wang, N. (2003). "Measuring Transaction Costs: An Incomplete Survey", Ronald Coase Institute, Working Paper Series, 2, February 2003.

Webber, C. and Wildavsky, A. (1986). *A History of Taxation and Expenditure in the Western World*, New York: Simon and Schuster.

Weber, D.W. (2002). “Pollution Permits: A Discussion of Fundamentals”, *Journal of Economic Education*, 33(3), 277-290.

Wegner, G. & Wieland, J. (1998). *Formelle und informelle Institutionen*. Marburg: Metropolis.

White, K. (1997). “SO_2 Compliance and Allowance Trading: Developments and Outlook”, Prepared for the Electric Power Research Institute (EPRI), EPRI TR-107897.

White, K., Energy Ventures Analysis, Inc and Van Horn Consulting (1995). “The Emission Allowance Market and Electric Utility SO_2 Compliance in a Competitive and Uncertain Future”, Prepared for the Electric Power Research Institute (EPRI), EPRI TR-105490, Palo alto, Calif.

Wieland, B., Seidel, T., Matthes, A. and Schlag, B. (2004). “Transport Policy, Acceptance and the Media”, Research Paper, Dresden Technical University, Germany.

Wieland, J. (1996). “Ökonomik der Transaktionsatmosphäre”. In: B.P. Priddat & G. Wegner (eds.). *Zwischen Evolution und Institution*, Marburg: Metropolis, 57-78.

Willett, T.D. (2000). “A Political Economy Analysis of the Maastricht and Stability Pact Fiscal Criteria”, In: Hallett, A.H., Hutchison, M. and Jensen, S. (eds.). *Fiscal Aspects of Monetary Integration*, Cambridge University Press, 37-68.

Williamson, O.E. (1979). “Transaction Cost Economics: the Governance of Contractual Relations.” *Journal of Law and Economics*, 22, 233-261.

Williamson, O.E. (1985). *The Economic Institutions of Capitalism*, New York: Free Press.

Woerdman, E. (2001). “Emissions Trading and Transaction Costs: Analyzing the Flaws in the Discussion.” *Ecological Economics*, 38, 293-304.

Woerdman, E. (2002). *Implementing the Kyoto Mechanisms: Political Barriers and Path Dependence*, The Netherlands: University of Groningen.

Woerdman, E. (2004). “Tradable Emission Rights.” In: Backhaus, J.G. (ed.) *Elgar Companion to Law and Economics*, Cheltemham: Edward Elgar (forthcoming).

Wrigley, C. D. (1997), “Design criteria for Electronic Market Servers”, *International Journal of Electronic Markets*, 7(4), 12-16.

Wurzel, E. (1999). “Towards more efficient government: reforming federal fiscal relations in Germany”, Economics Department working paper no. 209, OECD.

Wurzel, E. (2003). “Consolidating Germany’s Finances: Issues in Public Sector Spending Reform”, Economics Department Working Papers no. 366, OECD.

Zsolt de Sousa, H. (2004). “The Future of the Stability and Growth Pact as a Tool for Economic Policy Co-ordination”, Policy Papers, 9, Research and Policy Unit: Notre Europe.

Appendix

Figure 1: Deficit in % of GDP of Baden-Württemberg

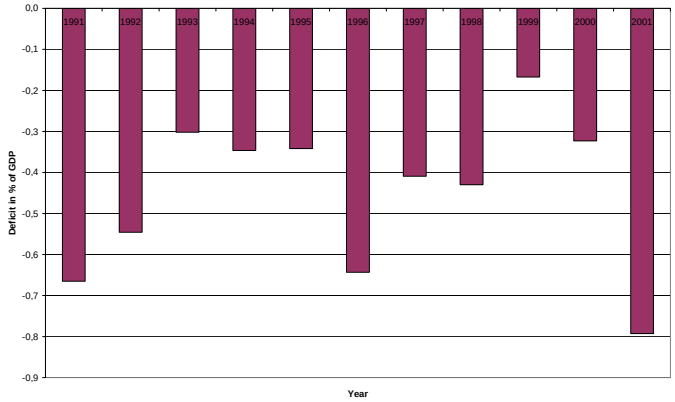


Figure 2: Deficit in % of GDP of Bavaria

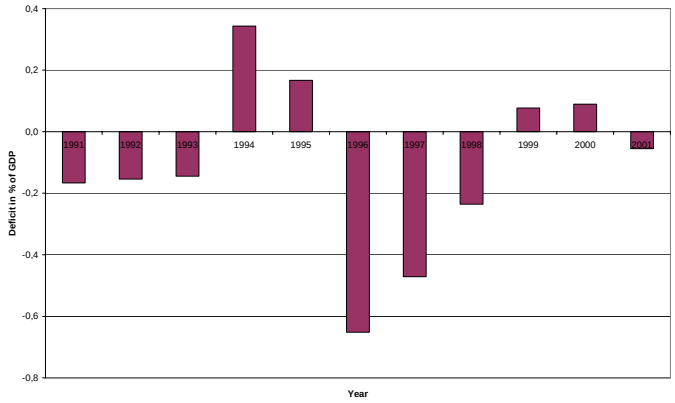


Figure 3: Deficit in % of GDP of Berlin

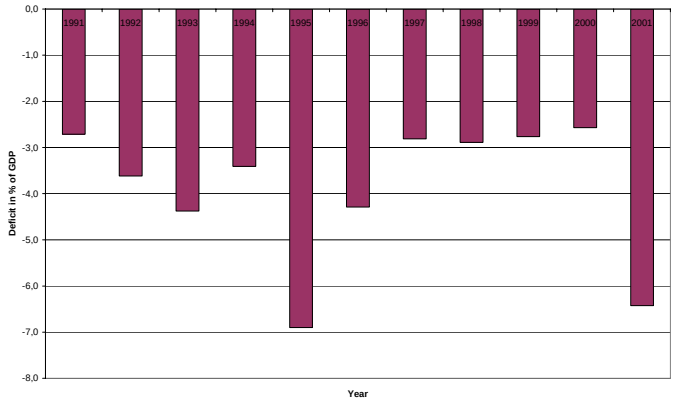


Figure 4: Deficit in % of GDP of Brandenburg

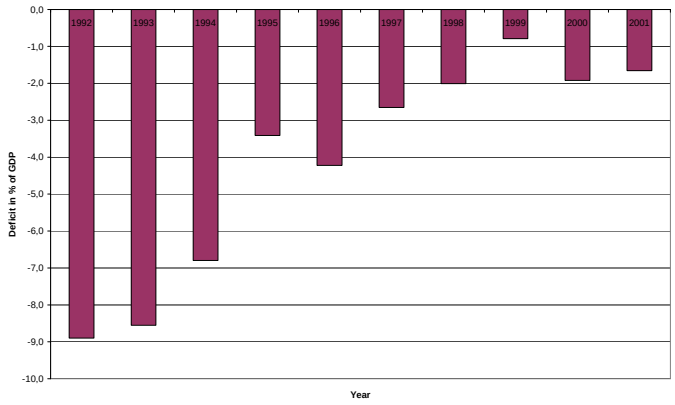


Figure 5: Deficit in % of GDP of Bremen

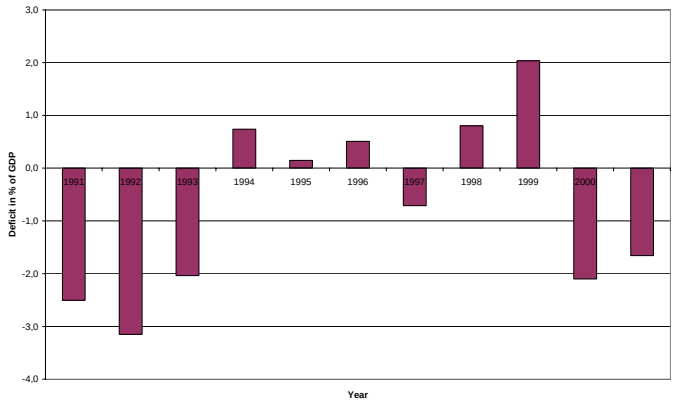


Figure 6: Deficit in % of GDP of Hamburg

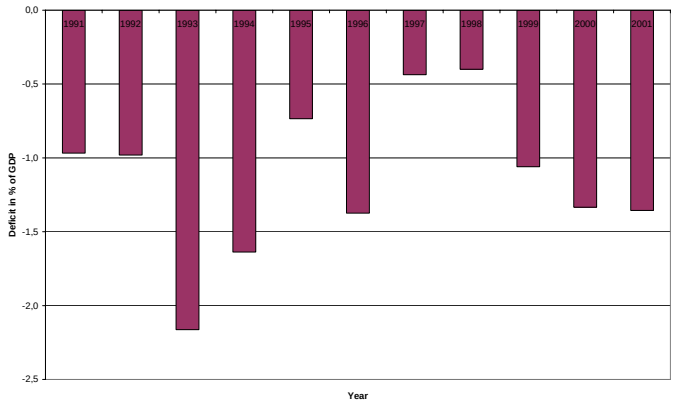


Figure 7: Deficit in % of GDP of Hesse

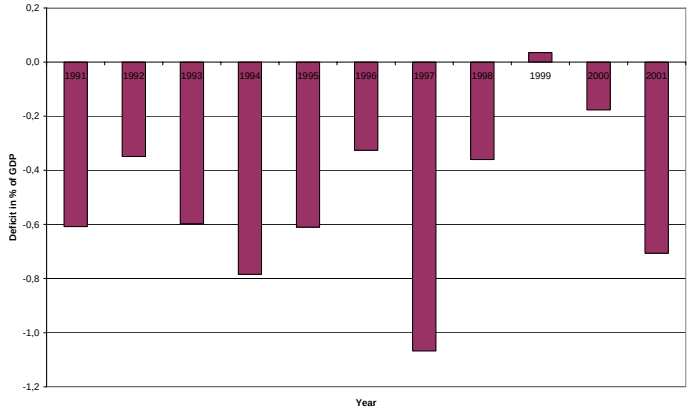


Figure 8: Deficit in % of GDP of Mecklenburg-Western Pomerania

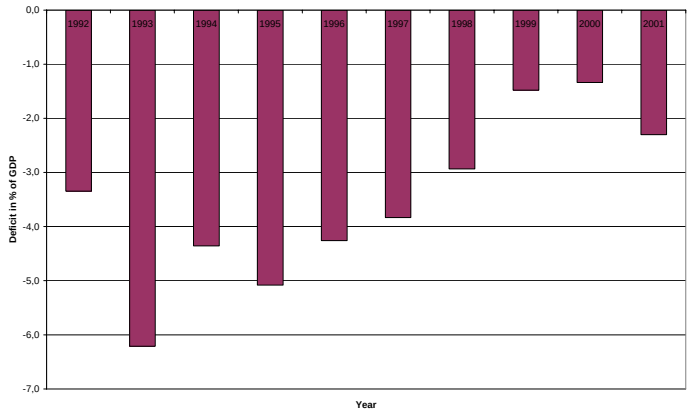


Figure 9: Deficit in % of GDP of Lower Saxony

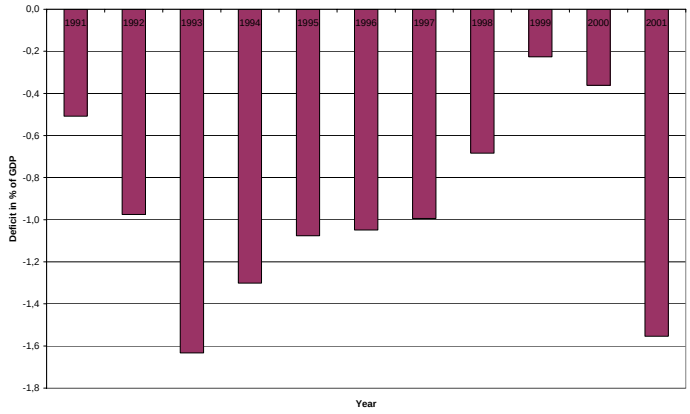


Figure 10: Deficit in % of GDP of Nord-Rhine Westphalia

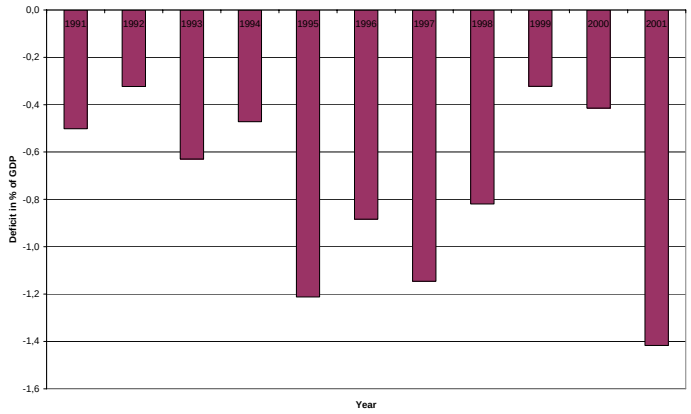


Figure 11: Deficit in % of GDP of Rheinland-Palatine

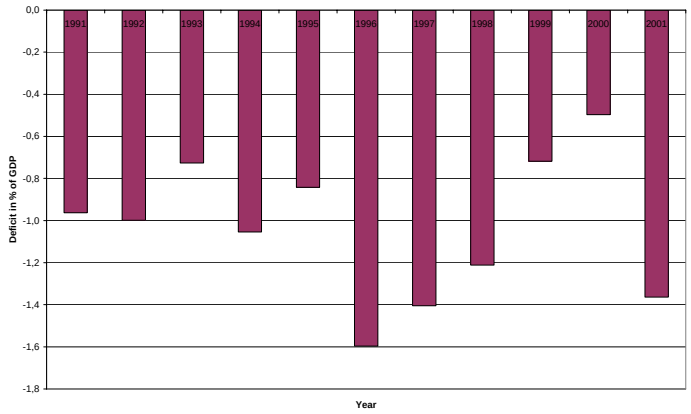


Figure 12: Deficit in % of GDP of Saarland

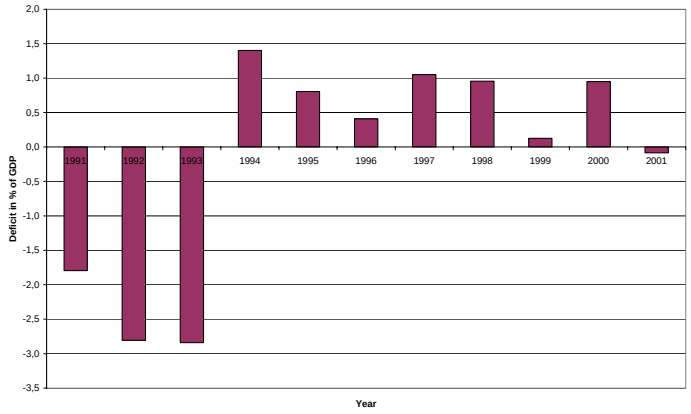


Figure 13: Deficit in % of GDP of Saxony

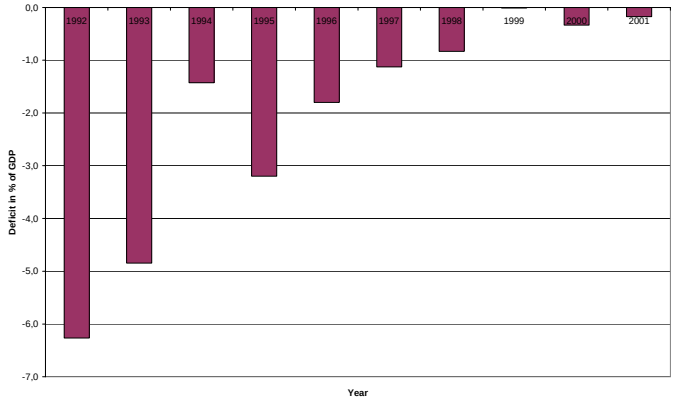


Figure 14: Deficit in % of GDP of Saxony-Anhalt

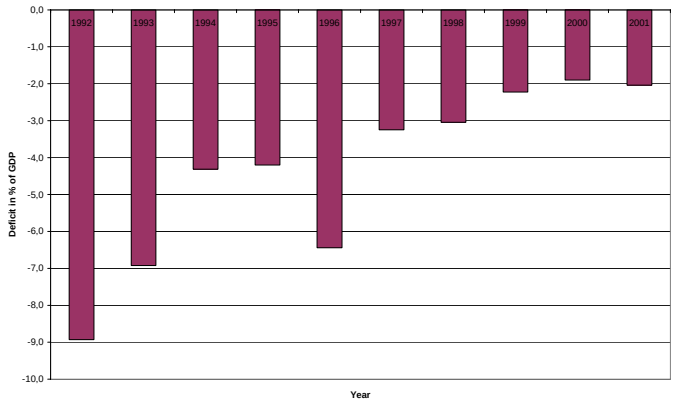


Figure 15: Deficit in % of GDP of Schleswig-Holstein

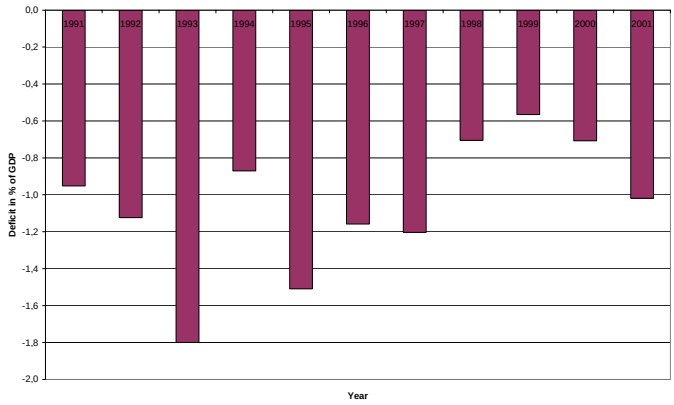


Figure 16: Deficit in % of GDP of Thuringia